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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Analyzing the determinants of agricultural credit accessibility for farmers in flood-prone regions

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**Abstract** Agricultural finance is essential for farmers in flood-prone regions because it offers them access to the money they need to keep their crops running. Crop losses, property damage, and other unforeseen expenditures are quite likely for farmers in flood-prone locations. The provision of agricultural loans is crucial in allowing farmers to minimise these risks and ensure the continuation of their farming operations. The variables affecting farmer's access to agricultural loans in a Pakistani region in danger of flooding are examined in this research. A structured questionnaire was utilized to gather information from one hundred and sixty-eight subsistence landowners in Khyber Pakhtunkhwa, Pakistan, using a multistage sampling method. According to empirical findings using a subjective slightest squares regression model with vigorous typical errors that accounted for heteroscedasticity, monthly income, family size, education, farming experience, total landholding, and the percentage of owned land were all important determinants of a farmer's ability to acquire loans. The results of this research show that socioeconomic determinants are very important for farmers' access to agricultural loans in Pakistani flood-affected regions. As a consequence, a credit policy is necessary to tackle the issues encountered by farmers who live in dangerous areas. Additionally, the present financing strategy may be altered to defend the rights of occupant cultivators who require security.

**Keywords:** agricultural credit, agricultural credit accessibility, farmers, flood-prone regions

## 1. Introduction

Farmers in flood-prone areas depend on the availability of agricultural financing because it gives them access to the capital they need to continue operating their farms. Farmers in flood-prone areas run a high risk of crop losses, property damage, and other unanticipated costs. A vital factor in assisting farmers to reduce these risks and guarantee the continuance of their farming activities is the availability of agricultural loans (Arifullah 2020). Farmers in flood-prone areas must have access to agricultural loans to maintain and expand their agricultural operations. Floods have the potential to seriously harm infrastructure and crops, which may reduce farmers' revenue. Therefore, having access to financing may aid farmers in both recovering from flood-related losses and making investments in defenses against further harm. Despite the need for financing for farmers in flood-prone areas, they often have trouble obtaining it because of things like a lack of collateral, a bad credit history, and steady revenue sources (Akter et al 2023). Along with contemporary technology, agricultural financing is a crucial factor in boosting farm output. In addition to large-scale farmers seeking agricultural financing to boost farm revenue, small- and medium-sized farmers also do so to ensure their existence. Compared to informal sources, official sources of credit are now more significant in the agricultural industry (Ahmad and Afzal, M.2022). Farmers have little recourse to formal financing despite the institutional sources of credit's growing relevance. Since the country's independence, agriculture has consistently been the most important contributor to the economy. Both official and informal lending practices are represented in Pakistan's rural credit market, each of which plays an important part in the country's rural economy (Qazlbash et al 2021).

Microfinance is especially significant for investments in rural production, which have traditionally been dominated by non-poor borrowers due to the limited availability of microcredit to those who are economically disadvantaged. It is of the utmost significance for farmers to get financial assistance for their social requirements, to buy agricultural supplies, and to achieve consistent advancements in their output levels (Rizwan et al 2019). While acknowledging the significance of the agricultural segment, has, over many years, developed agricultural credit policies to fund farmers' output with the goals of boosting agricultural productivity and ensuring that there would always be food available. Credit for agriculture has the potential to improve the management effectiveness of farmers, hence fostering more effective resource allocation and increased profitability. Farmers need to have timely access to credit as well as the availability of credit to purchase the

appropriate inputs and equipment necessary to carry out farming activities. When compared to informal sources of credit, the process of gaining access to official sources of finance may be much more difficult for farmers. Small-scale farmers lack the assets and collateral that large-scale farmers have, hence the latter have less access to formal finance (Ao et al 2022). Most small-scale farmers have limited access to both official and informal sources of credit, including friends, family, and landlords, in addition to restricted access to formal sources of credit. Contracts in informal loan markets tend to be more individualized. Everyone who is pre-qualified to disburse the attention and fulfill the security criteria is likely to get credit from all lenders and various borrowers, according to personal contacts. The main issue facing farmers is restricted access to finance or financial limitations, which prevent the adoption of more advanced and efficient technology in the agricultural industry. This paucity of resources restricts both the potential for higher output and the ability for efficient consumption (Fahad et al 2022). Following harvest, farmers need money for the next growing season to offset financial deficits and unpaid bills for their most recent crop. Additionally, high-yielding seeds, pricey fertilizers, and plant protection techniques form the foundation of contemporary agriculture. The majority of their supplies are bought in cash or on credit-in-kind terms from dealers, which places farm families in greater reliance on the credit markets. Farmers that have quick and simple access to loans may grow and diversify their agricultural operations by making new investments or using cutting-edge technology. The biggest barrier preventing Pakistani farmers from taking advantage of loan programs is a lack of collateral. Small-scale farmers find it difficult to get formal credit owing to problems with collateral; as a result, they turn to informal sources because of their prompt delivery, and lack of requirements. Due to a lack of collateral security, the mainstream's tiny range of farmers is unable to sponge money from bank organizations. Minor-scale farmers often only qualify for minor loans to buy seeds, fertilizer, and pesticides and are unable to be appropriate for loans to buy tractors, pipe wells, and agricultural equipment because they lack enough collateral (Ahmad and Afzal 2021).

Saqib et al 2018 investigated the elements affecting farmers' entrance to farming loan in a Pakistani region in danger of flooding catastrophe. Prearranged questionnaire were utilized to gather information from one hundred and sixty-eight subsistence landowners, using a multistage sampling method. According to the empirical findings of the biased slightest squares deterioration model with vigorous typical errors and heteroscedasticity correction, characteristics such as whole landholding, monthly profits, relations dimension, education, farming experience, and the percentage of own ground be important determinants of farmer's entrance to credit. The results show that socio-profitable determinants are very important for farmers' access to agricultural loans in Pakistani flood-affected regions. Both secondary and primary data were analyzed by Saqib et al (2018); resultant statistics be gathered from the State Bank of Pakistan's and Pakistan Economic Survey's yearly reports. The results also showed that inferior and intermediate continuation farmers had the greatest levels of acknowledgment shortage of cash for agricultural ventures. Age, family size, education, experience, the total amount of land a farmer had, & the percentage of his or her land all had an impact on how adequate an agricultural loan was, according to the Tobit regression findings. Fahad et al (2018) investigated the variables affecting Pakistani farmers' decision to use crop insurance as a risk management tool. A systematic questionnaire was used to gather primary information from 400 farm families in four flood-prone areas of the northwest. The results of this research are anticipated to direct policymakers, insurance providers, and the government in establishing crop insurance. For the benefit of small farmers, the government should also fund crop insurance policies, and crop insurance knowledge has to be raised. Owusu and Yiridomoh (2021) examined the variables that underlie the usage of these tactics as well as the ex-post-targeted responses that women cultivators make in the face of adverse weather and climatic conditions. The study created a multivariate probit model to investigate the problem using sub-sectional data from a model of women farmers in Ghana's Upper West Region who had been exposed to weather extremes. Zulfiqar et al (2021) investigated the factors that influence access to agricultural loans. The probit model was utilized in this research to examine the data. The results revealed that although the farmer's age, location, and off-farm proceeds had an unconstructive and negligible result on the entrance to farming financing, the degree of mechanization had a positive and substantial influence. The results of this research provide a strategic direction for streamlining national agriculture finance strategy. Linh et al (2019) concentrated on the characteristics of rural credit markets, the elements affecting cultivator entrance to markets, and the socio-economic impacts of loan availability in Vietnam. The findings of this investigation point to the segmentation, government interference, and participation limits that characterize Vietnam's markets. The significant factors that affect credit convenience are shown by other findings. Chandio et al (2020) investigated how smallholder farmers' socioeconomic traits affect loan demand in Sindh, Pakistan. The findings showed that the desire for formal credit was positively and substantially impacted by formal education, agricultural experience, and the size of landholdings, road access, and extension connections. Akdemir et al (2021) looked at the determinants affecting farmers' access to agricultural loans in the region of Adana, Turkey. A sample of 101 producers who had received training in basic random was subjected to questionnaire-based surveys. In this study, the factors influencing farmers' access to agricultural loans in a Pakistani area at risk of floods.

## 2. Material and Methods

### *2.1. Study Area and Sampling*

An approach called multi-stage sampling was utilised to get the data. Khyber Pakhtunkhwa was chosen on purpose first. For a second sample, a vulnerable rural population was chosen. In Khyber Pakhtunkhwa Mardan District, 970 agricultural families were found to be particularly susceptible. One hundred and sixty-eight farm households were chosen as the model dimension using Yamane's technique with a 7% margin of error. Third, information was collected from 168 subsistence farm families with landholdings of up to 12.5 acres using a simple random selection method.

2.2. *Study Variables*

*2.1.1. Dependent Variable*

The relation of the quantity of recognition obtained by farmers to the size of their landholdings, as described in equation (1), served as the study's dependent variable, which was access to agricultural finance.

$$Z_{ji} = \frac{proportion\ of\ credit\ received\ by\ farmers\ to\ total\ credit}{proportion\ of\ landholding\ of\ farmers\ to\ total\ landholding} \quad (1)$$

Where $Z_{ji}$ defined entrance to acknowledgment; i defined agricultural household, and j defined either an official.

*Independent Variables*

In this research, the following were used: experience, and monthly income, education, age, size of the landholding, distance, health status, family size, percentage of owned land, and percentage of field laborers. The variables' definitions, measurements, means, and standard deviations are listed in Table 1.

**Table 1** Detailed descriptions, measurements, means, and standard deviations for the variables.

| Variable | Description | Measurement | Mean | Standard Deviation |
|---|---|---|---|---|
| Dependent variable | | | | |
| $Y_{ij}$ entrance to farming credit | agriculture credit availability | Specified in equation (1) | | |
| independent variables | | | | |
| Independent variable | 0.94 | | | |
| $v_1$Total landholding | | | | |
| $v_2$Family size | Landholding size | In acres | 46.8 | 12.5 |
| $v_3$ Owned land proportion | Total number of family members | Number | 2.3 | 12.1 |
| $v_4$ Age | amount of own ground of the whole | | | |
| $v_5$ Distance | Ratio | 0.41 | 0.52 | |
| $v_6$ Monthly income | Farmers' age | In years | 45.7 | 14.7 |
| $v_7$ Education | Farm distance from the river | 500 m | 0.31 | 0.42 |
| $v_8$ Farm labor | Average monthly income | In PKRa | 0.55 | 0.41 |
| $v_9$ Farming Experience | agriculture education | Year of education | 0.6 | 0.48 |

*2.2.2. Regression Model*

Regression using weighted least squares was used to investigate the variables affecting loan availability. The model was described in equation (2) as follows:

$$Z_{ji} = e(v_1, v_2, v_3, v_4, v_5, v_6, v_7, v_8 v_9) \quad (2)$$

The empirical model was described by equation (3) as follows:

$$Z_{ji} = \beta_0 + \beta_1 v_1 + \beta_2 v_2 + \beta_3 v_3 + \beta_4 v_4 + \beta_5 v_5 + \beta_6 v_6 + \beta_7 v_7 + \beta_8 v_8 + \beta_9 v_9 + \varepsilon_j \quad (3)$$

Where $Z_{ji}$ as previously described, i stand for the coefficients, and $\varepsilon_j$ stands for the random error term. The independent variable was normalized through the disagreement of credit entrance using weighted least squares regression.

## 3. Empirical Results

Multicollinearity was examined before model estimation for all socioeconomic components in which the VIF values was relatively low, suggesting no multicollinearity. These findings are shown in Table 2 alongside the regression results.

**Table 2** Empirical findings of robust weighted least squares regression with heteroscedasticity correction.

| changeable | Coefficient | *p* | VIF |
|---|---|---|---|
| $X_1$ Age | —0.006 (0.009) | .480 | 1.93325 |
| $v_1$ Family size | 0.059 (0.0245) | .017* | 1.47649 |
| $v_2$ Farming experience | 0.0258 (0.0126) | .042* | 2.23938 |
| $v_3$ Farm labor | —0.098 (0.073) | .181 | 2.1517 |
| $v_4$ Education | 0.083 (0.0274) | .003** | 1.41175 |
| $v_5$ Total landholding | 0.216 (0.0333) | .000** | 1.76491 |
| $v_6$ Monthly income | —1.31 × 10—6 | .000* | 1.71542 |
| $v_7$ Farm labor | —0.098 (0.073) | .181 | 1.29654 |
| $v_9$ Family size | 0.059 (0.0245) | .017* | 1.47745 |
| Constant | —0.751 (0.457) | 0.110 | |
| Sum square residuals | 1414.210 | SE of regression | 3.312991 |
| R-squared | 0.548754 | Adjusted R-squared | 0.5237 |

Additionally, the correlation matrix for each research variable was created and is shown in Table 2. Heteroscedastically corrected weighted least squares deterioration through resilient typical errors was used to address the heteroscedasticity issue using cross-sectional data. Here, the dependent variable (access to credit) variance served as the weight. Figures 1, 2, and 3 displays the expected, actual, & residual plot of the entrance to tribute to illustrate the normality of outstanding.

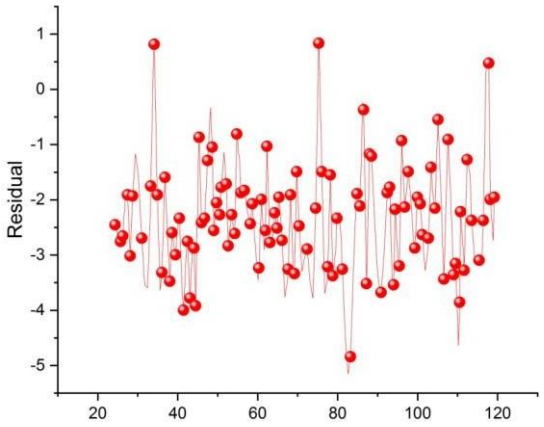


**Figure 1** Actual values of access to credit model.

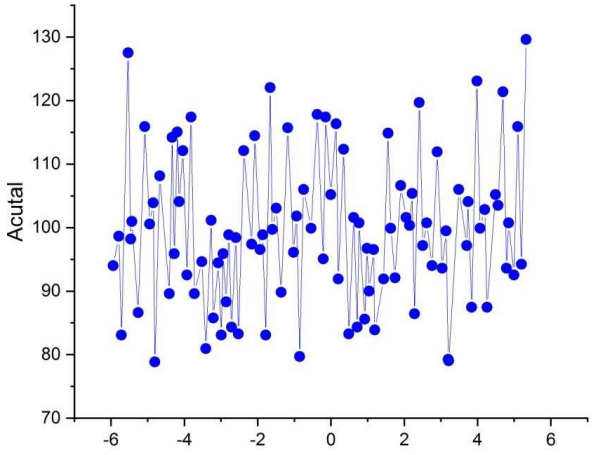


**Figure 2** Predicted values of access to credit model.

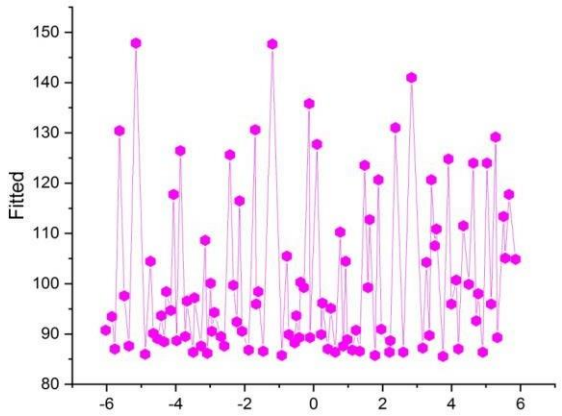


**Figure 3** Residual values of access to credit model.

**Table 2** Correlation matrix.

| | X | Y1 | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 | Y8 | Y9 |
|---|---|---|---|---|---|---|---|---|---|---|
| X | 1 | | | | | | | | | |
| Y1 | 0.325 (0.000) | 1 | | | | | | | | |
| Y2 | 0.471 (0.000) | 0.152 (0.214) | 1 | | | | | | | |
| Y3 | 1.421 (0.000) | 0.456 (0.000) | 0.152 (0.003) | 1 | | | | | | |
| Y4 | 0.632 (0.000) | 0.412 (0.000) | 0.455 (0.000) | 0.411 (0.000) | 1 | | | | | |
| Y5 | 0.125 (0.714) | 0.161 (0.021) | 0.002 (0.971) | 0.201 (0.002) | 0.164 (0.031) | 1 | | | | |
| Y6 | 1.141 (0.532) | 0.154 (0.042) | 0.214 (0.003) | 0.232 (0.000) | 0.291 (0.000) | 0.311 (0.000) | 1 | | | |
| Y7 | 0.245 (0.000) | 0.164 (0.023) | 0.365 (0.000) | 0.212 (0.004) | 0.391 (0.000) | 1.247 (0.000) | 0.411 (0.000) | 1 | | |
| Y8 | 0.111 0.485 | 0.052 (0.412) | 0.211 (0.001) | 0.120 (0.127) | 0.255 (0.000) | 0.111 (0.000) | 0.202 (0.000) | 0.441 (0.000) | 1 | |
| Y9 | 0.491 (0.000) | 0.311 (0.000) | 0.325 (0.000) | 0.151 (0.000) | 0.411 (0.000) | 0.11 (0.000) | 0.131 (0.010) | 0.202 (0.007) | -0.005 (0.010) | 1 |

Mean reverting indicates that the residuals (error terms) are independently normally distributed with a zero mean and a constant variance. The coefficient of determination (R2 ¼ 0.55) indicated that the model had a strong fit and that the independent variables were responsible for 55% of the differences in farmers' access to loans. The F-statistic importance of 21.36 (p less than .01) shows that the independent factors did, in fact, substantially impact farmers' access to loans. Farmers' ability to acquire loans was strongly impacted by the education variable (p < .01). According to this, farmers' ability to acquire agricultural financing rises by 0.083 units for every year that their education increases. Similar to that, every extra year of agricultural expertise improves credit availability by 0.0258 units (p less than .05). Additionally, the overall landholding was significant (p less than .01), which suggests that a one-acre increase in land holdings boosts entrance to credits.

Additionally, adding one member to a family boosts admission to recognition for farmers (p less than .05). Furthermore, access to credit was considerably improved (p less than .01) by the ratio of owned land to total land ownership. Lastly, while the impact was minimal (p less than .01), monthly revenue had a pessimistic significant impact on access to farming financing (Table 2).

## 4. Discussion

As a consequence of improved technical knowledge, a better awareness of recognition markets and services, improved know-how and agricultural abilities, and awareness of practical processes, the findings show that farmers' access to credit rose in correlation with higher levels of education. Farmers with higher and secondary levels of education have access to finance more often than their less-educated competitors. The study's findings are supported by the study's outcomes. They said that the family can manage the processes needed to get loans due to the household leaders' educational backgrounds. Education thus has a significant impact on borrowing choices and lowers the transaction costs associated with

loans. They discovered a strong link between schooling and livestock credit. Furthermore, the majority of a cultivator in the field was illiterate & were unclear about the steps needed to get loans from official sources. For example, they couldn't even comprehend and complete the loan application paperwork on their own. According to our research, farmers' access to credit grew as their level of expertise increased, indicating a favorable association between farming experience and agricultural finance. Farmers with greater expertise had stronger relationships with other farmers, money lenders, and dealers, which improved their access to finance from informal sources. Building trust between borrowers and lenders takes time. For example, it has been said in the field that one's connections and farming expertise play a role in receiving credit for the growing of vegetables and melons.

Compared to relatively young farmers, farmers who established ties with credit providers for a longer period were more likely to have easy access to such finance. The cost of the credit would stay cheap since seasoned cultivators would have interacted with a bank to obtain loans multiple times in the precedent. In the event of obtaining official credit, prior farming experience is also crucial. Our findings are consistent with those of other researchers, who found a link between previous farming experience and access to agricultural loans. Similarly to this, farmers with more official sources of finance had far better associations with cooperatives. Our results indicate a considerable positive correlation between the extent of landholdings and farmer's loans. The size of the landholding is seen as a sign of social standing in society. Lack of collateral prevents many renters and landless people from accessing the official loan markets. According to the terms for loans outlined in the Agricultural Development Bank of Pakistan's rules, submitting a land ownership certificate is required for the loan to be approved. Compared to farmers with larger landholdings, the majority of farmers had restricted access to financing because of their modest landholding size. These results support the conclusions of several earlier types of research on the advantageous link between loan availability and the size of landholdings. Land ownership and loan availability were unrelated. Our data show a negative correlation between monthly income and loan availability for agricultural purposes. Access to credit declined as income levels. Our outcomes run counter to this, showing that respondents with comparatively higher wages respondents with relatively lower salaries.

Additionally, there was no discernible connection between income and agricultural finance availability. The empirical findings demonstrate a favorable correlation between family size and loan availability. Farmers needed credit for agricultural productivity as their families' requirements for food and other necessities rose along with the growth of their families and their reliance on the farm. In contrast, farmers who had small families could cover their expenses from their agricultural revenue. The ability of larger families to diversify their agricultural income by selling cattle, and other agricultural products that would otherwise need large amounts of credit is another factor contributing to the favorable correlation. Large families are also likely to have more connections with traders and merchants who might facilitate obtaining loans. Our results are in line with earlier research that showed that family size has a substantial impact on loan availability. The findings indicate that farmers' access to finance was favorably impacted by the percentage of owned land. The land ownership certificate, or intiqaala in Urdu, was the primary type of collateral required. The original owner is necessary for these papers, which may be obtained from the District Revenue Office. As a result, renters who do not own land are unable to get loans from this official source. In rare instances, banks demand gold as security before approving a loan. Since the majority of farmers lack gold, silver, real estate, or other assets that may be used as security. Property ownership is another crucial component of informal credit, and the majority of traders, merchants, and middlemen only lend to farmers who have their property. The findings of our research are consistent with those of other studies, which found that farmers' access to agricultural financing was highly impacted by their land ownership status. Additionally, changes may be made to the acknowledgment plan in particular and the farming procedure generally to safeguard the interests of occupant cultivators who require an adequate form of security.

## 5. Conclusion

The foundation of Pakistan's economy is agriculture. 43.5 percent of the rural population relied on it as a source of income, and it generated 20.9 percent of the GDP in 2014-15. In Pakistan, agricultural production has been the major driver of economic development, increasing at a standard yearly rate of 4.4 %. Farmers in Pakistan struggle to get access to agricultural loans. In Pakistan's flood-prone regions, this study investigates the variables disturbing cultivator entrance to agricultural loans. Data from one hundred and sixty-eight subsistence landowners in the Khyber Pakhtunkhwa Mardan District were gathered using multistage sampling and a structured questionnaire. The results of this research show that socio-economic determinants are very important for farmers' access to agricultural loans in Pakistani flood-affected regions. Farmer’s access to credit was favorably impacted by experience, education, amount of landholdings, number of families, and percentage of owned land, however, monthly income showed a negative correlation. The majority of farmers lacked the necessary collateral to get loan from legal sources, as well as sometimes from informal ones, and were illiterate. Farmers in these disaster-prone flood zones need more loans to support their agricultural pursuits. Credit is thus necessary.

## Ethical considerations

Not applicable.

## Declaration of interest

The authors declare no conflicts of interest.

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Leveraging a novel machine learning approach to forecast income and immigration dynamics

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**Abstract** Migration is one of the most important topics to emerge in the history of humanity. It is essential to anticipate human migration as exactly as possible in a variety of circumstances, including urban planning, trade, epidemics, the global expansion of diseases, and pandemic preparation, in order to generate successful public policy. Estimating potential future earnings for an individual, a firm, or an entire industry may be accomplished via the use of income projections. These data might be put to use to identify potential areas for growth and investment, as well as to devise strategies for adjusting both the employment landscape and the economy as a whole. It is possible to anticipate immigration by applying machine learning (ML), a technique that is presently used in almost every facet of modern life. In this research work, we presented the ML-based swarm-optimized binary regression-based xgboost method (also known as SO-BRXGB). According to the results of the research, the SO-BRXGB algorithms were the ones that were the most successful in the applications. In conclusion, the machine learning models for human migration prediction that were applied in this study will offer a flexible framework for predicting human migration under a variety of situations.

**Keywords:** migration, machine learning, SOBRX, income

## 1. Introduction

Migration is any movement of a population that results in the displacement of one or more groups of citizens, regardless of how long the migration lasts, what its cause is, or what its nature is. People have moved throughout history for a variety of reasons, including but not limited to conflicts, climatic circumstances, forced relocation, natural catastrophes, as well as political, policy, and economic considerations (Akujobi and Awhefeada 2021). It is a well-known truth that people and groups move away from the areas where they were born and raised to seek opportunities elsewhere. Individuals who relocate for various reasons, including to be with family, are included in the category of migrants. These migrants include refugees, individuals who have been displaced within their own country, economic migrants, and people that move for a variety of reasons (McClain et al 2022). The influence of immigrant landings on native-born workers' employment and salaries is often the main topic of discussion among the public regarding the economic effects of immigration. In the early 20th century, analysts disputed how immigration limitations would likely affect the labor market (Borjas 2019).

It is occasionally asserted that the immigration boom has significantly boosted the nation's economy and that bringing in even more immigrants might boost our country's prosperity even further. However, these assertions typically appear in reports written by organizations of thought, policy advocates, and business organizations. Not many scholarly researches show a connection between immigration and growth (Inwood et al 2019). To begin, the variability of any estimator is decreased as a direct result of the fact that the income indicator is constant across all of the observations with the same occupation. Simply reducing the variation will have the effect of narrowing the projected wage difference between immigrants and native-born people from other countries (Abramitzky et al 2019)

Estimates and breakdowns of the precise migratory patterns of possible nations may be carried out using models and algorithms developed by machine learning. The information era in which we now find ourselves reveals to us that it is feasible to utilize AI to make a variety of predictions regarding migration, which is something that occurs in almost every aspect of life. For governments that wish to make preparations against the migration issue, for instance, it may be helpful to estimate the total amount of immigrants, income categories, and other data by using techniques and methods of artificial intelligence (AI) (Hussain 2021).

The article (McAuliffe et al 2021) critically investigate how rising digitalization and AI will affect movement and transportation systems in a post-COVID global world. It begins by examining the effects of digitalization and AI adoption across the migration cycle. The second part of the paper looks at the challenges and opportunities that migration systems and migrant populations face as a result of COVID-19's increased digitalisation. The paper (Beduschi 2021) suggest artificial intelligence

(AI) technology can affect the field of international immigration administration in a number of different manners: (1) by escalating existing discrimination between states on a global scale; (2) by transforming status and globally recognized organizations traditions; and (3) by that promotes current calls for more research-based migration management and border protection. The paper (Lindström et al 2020) used research techniques like interviews, focus groups, shadowing, and interactive workshops are employed, along with a mixture of quantitative and qualitative research approaches. The study and identify the obstacles and possibilities that AI implies to aid migrant job integration during six work packages (WPs). The research of Robinson and Dilkina (2018) suggest machine learning methods forecast origin/destination human migration patterns that may include any external factors. On several assessment parameters, models based on machine learning perform better than conventional human mobility theories when predicting both domestic and international migration.
In the classification step of the data analysis process, a predictive model or classifier is built to forecast categorical labels. The process of placing items in a collection into distinct categories is referred to as classification, and it is one of the data mining techniques. The purpose of categorization is to accurately determine which category should be assigned to each individual instance in the data Tarasyev et al (2018). In order to examine how weather shocks affect a person's desire to migrate in the six economies that rely heavily on agriculture, such as Burkina Faso, Ivory Coast, Mali, Mauritania, Niger, and Senegal, this research presents a tree-based Machine Learning (ML) technique. Using the train-validation-test procedure, we run a number of tree-based algorithms to create reliable and noise-resistant methods (Aoga et al 2020). The research Harrison et al (2020) proposed a framework for predicting the migratory paths of these displaced people using well-established machine-learning techniques. My algorithms successfully forecast 80% of IDPs' movement paths in a case investigation into displacement in Yemen.

The three areas used to assess migration management strategies are 1) legal issues, 2) policing agents and relationships, and 3) surveillance. The paper Lüleci-Sula and Sula (2021) used a multimethod approach that combines the gathering of qualitative data with interpretative analysis. By examining problems and presumptions related to its implementation, the study problematizes the concept of skill level. The study Hayakawa (2020) investigated the experiences of professional and low-skilled Filipino migrants in the UK after reviewing the UK's temporary migration programs.

## 2. Materials and Methods

In this section, we discuss in detail about leveraging a novel machine learning approach to forecast income and immigration dynamics. Our method entails gathering and preprocessing information on income levels and immigration trends, identifying pertinent features, and creating a prediction model using the swarm-optimized binary regression-based XGBoost algorithm. In order to improve our model's hyper parameters, we apply swarm optimization methods, and we additionally use metrics to assess the model's effectiveness.

### *2.1. Swarm-Optimized Binary Regression-Based Xgboost (SO-BRXGB)*

#### *2.1.1. Binary Regression-based Xg boost*

Based on binary regression, a machine learning technique called XG Boost could be used to forecast immigration and income trends. Recognizing economic patterns and making wise judgments depend on being able to predict income and immigration. Predictions that are accurate may assist people, corporations, and politicians in making future plans. We may gather and preprocess data on income levels and immigration trends and then utilize this information to train the Binary Regression-based XG Boost algorithm in order to forecast the dynamics of income and immigration. The algorithm's ability to automatically choose the most crucial characteristics lowers the danger of overfitting and enhances the model's generalization capabilities.

To provide accurate forecasts of income and immigration dynamics, the Binary Regression-based XG Boost method may combine a number of data sources, including data on demographics, indicators of the economy, and social media activity. These forecasts, which provide insights into upcoming economic and social trends, may help with legislation, company planning, and individual decision-making.

There are two types of regression analysis (RA): linear regression and nonlinear regression. However, this research used SPSS and linear regression (LR) to analyze a number of factors. LR is a numerical approach that estimates the output of a reported parameter using a number of descriptive parameters. The LR approach is used to find the parameters' best-fit relationship. The relationship connecting independent (input) and dependent (output) factors may often be established using LR. In this work, Es and Ed were predicted using the LR method, respectively. Usually, Equation 1 may be used to represent the LR relationship between the inputs and outputs.

$$T = e + P_1Y_1 + P_2Y_2 + P_3Y_3 + \cdots + P_mY_m \qquad (1)$$

Where the input variables $Y1\ to\ Yn$ are the inputs, D represents the output parameter, stands for the regression constant, and $P1\ -\ Pn$ are the coefficients of regression.

The developed linear formulas, as stated in Eqs 2 and 3, forecast Es and Ed based on the effects of LR.

$$A_G = 0.086UCS + 26.55\ Density + 0.014Vb - 0.004Vs - 89.47 \quad (2)$$

$$A_t = 14.568\ Density + 0.008Vo - 0.15Vs - 0.034UCS - 64 \quad (3)$$

Where $A_G$ and $A_t$ are the corresponding static and dynamic Young's moduli in GPA. VP and Vs. are the p-wave and s-wave velocities, while UCS stands for uniaxial compressive strength in MPa, respectively.

It is regarded as a potent tool by data scientists since it is a strong tree-based ensemble learning method. Based on a gradient-boosting architecture, XG Boost estimates the outcomes using Eq. 4 and a variety of complement functions.

$$x_j = x^0_1 + \eta \sum^{m}_{r=1} e_r\ (W_j) \quad (4)$$

Where r = 1 ton denotes the power source number of estimation methods that correspond to autonomous tree structures for each $e_r$; $x_j$ indicates the estimated output for the j [th] data with the parameter to be used vector $W_j$; and $x^0_1$ demonstrates the primary school hypothesis, and there is genuinely the mean of the distinctive variables in the training data. Overfitting is a real issue that often arises in machine learning. Hence the statistical model must be created with less of it. The XGBoost model determines the training phase in a complementary manner.

The rth estimator is linked to the model following Eq. 3 in the k[th] stage, and in the next step, the predicted value of the $r$th $x^{-r}_j$ is determined from the predicted result$x^{-(r-1)}_j$. The constructed $e_r$ of the rth complementing estimator is indicated in Eq. 5.

$$x^{-r}_j = x^{-(r-1)}_j + \eta\, e_r \quad (5)$$

Wherein $e_r$ stands for the leaves weight, which is determined by lowering the rth tree's objective function and is provided by Eq. 6.

$$e_{obj} = \gamma^H + \sum^H_{e=1} [s_e u_e + \frac{1}{2} (\xi_e + \lambda) u^2_e \quad (6)$$

Where Z is the number of leaf nodes, is the complexity parameter $\gamma$, is the constant coefficient, and $u^2_e$is the leaf weight in units of one to H. The regularization parameters $\gamma$ and $\lambda$ are used to strengthen the model and prevent over-fitting. The combination parameters for the whole dataset that are connected to a leaf of the initial and prior loss function gradient, respectively, are $s_e$ and$s_e$. A leaf is divided up into multiple leaves to construct the k[th] tree. By utilizing the gain parameters described in Eq. 7, such a system is indicated.

$$S = \frac{1}{2}[\frac{Q^2_F}{B_F+\lambda} + \frac{Q^2_K}{B_K+\lambda} + \frac{(Q_F+Q_K)^2}{B_F+B_K+\lambda}] \quad (7)$$

Where S stands for the gain variables, $Q_k$for the left leaf, and $B_K$ for the right leaf; the left leaf's following division is indicated by the letters $Q_F$ and $B_F$, respectively. The division criteria are often taken into consideration when the increased parameter is close to zero. Regularization parameters $\lambda$ and $\gamma$ are dependent on the gain parameters indirectly. To prevent the leaf convolution phenomena, for instance, a bigger regularization value might dramatically lower the gain parameter. However, this will make the model less capable of adjusting to the training set of data.

*2.1.2. Swarm Optimization (SO) Model*

The SO algorithm is modeled like a flock of birds hunting for food in a multidimensional search space. The key SO criteria that are utilized to determine the ideal value are position and velocity.

A particle is a single entity that starts out in the search space with a random location and velocity. The best global particle is located at the following spot in the ideal solution:

$$c^{d+1}_j = u.w^s_j + v_1.rand_1 \times (bbest - y^d_j) + v_2.rand_2 \times (sbest - y^d_j) \quad (8)$$

$$y^{d+1}_j = y^d_j + c^{d+1} \quad (9)$$

Where the $j$[th] particle's velocity at iteration numbers $(d)$ and $(d+1)$ is represented by the variables $c^{d+1}_j$ and$c^{d+1}$. Typically, the random integers in (0, 1) are rand1, rand2, and$v1 = v2 = 2$. The formula for the w is:

$$u(d) = u^{max} - \frac{(u^{max}-u^{min}).D_j}{D_{max}} \quad (10)$$

Where $u^{max}$ is equal to 0.9, $u^{min}$ is equal to 0.2, and $D_{max}$ is the largest number of iterations.

## 3. Results

The quality of employment possibilities for highly educated immigrants is described in section 4.1 characterized by financial status and knowledgeable skill level when combined with additional important parameters like admission path as well as the year of migration; and in the remaining subsection, we present and talk about the outcomes of our r. Employment possibilities of highly educated migrants are presented by citizenship, acceptance route, major origin country, and year of migration.

### *3.1. Access to Employment for Migrants with High Education*

According to the theoretical predictions of the human capital theory, Figure 1 depicts the job opportunities of immigrants and natives by educational attainment. The higher the educational attainment, the higher the employment rates amongst both categories of immigrants and natives. This claim, however, only holds true if we examine both of these categories separately: not only is the proportion of native men with high levels of education who are employed greater compared with that of their immigrant counterparts, but the rate of employment is also marginally higher between native men with the lowest levels of education than among well-educated immigrants. Figure 1 for immigrants and natives shows a similar gender disparity, which narrows (and almost vanishes) with greater education. Table 1 shows the results of employment levels according to education.

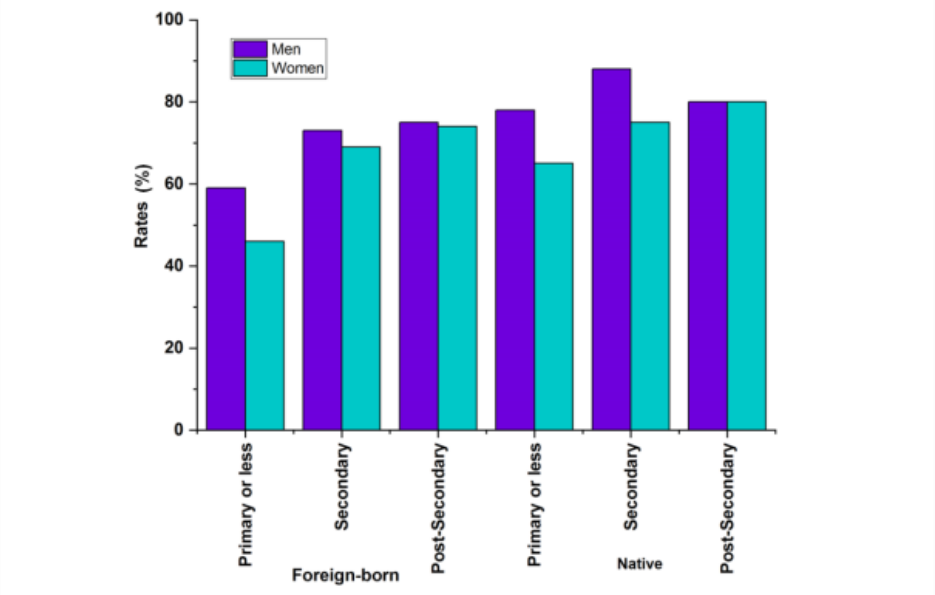


**Figure 1** Employment levels of immigrants and citizens according to education.

**Table 1** Results of employment levels according to education.

| Foreign-born | Rates | |
|---|---|---|
| | **Women** | **Men** |
| Secondary | 69 | 73 |
| Primary or less | 46 | 59 |
| Post-Secondary | 74 | 75 |
| Secondary | 75 | 88 |
| Primary or less | 65 | 78 |
| Post-Secondary | 80 | 80 |

The evidence suggests that naturalized immigrants do better in the labor market compared to individuals with foreign nationality. These results hold true for immigrants with each of the three educational levels, according to our descriptive data on job placement rates of immigrants by schooling and being a citizen, as shown in Figure 2. Men have a modest advantage, although both citizen and non-citizen immigrants with just an elementary school experience the biggest gender difference. Studies on the integration of immigrants into the labor market also reveal that workers have better job prospects and results than refugees and family migrants. Table 2 shows the results of immigration employment rates.

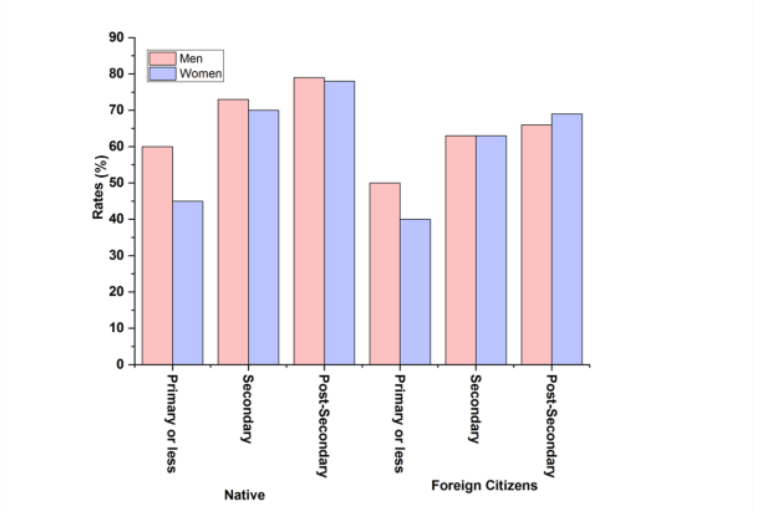


**Figure 2** Immigration employment rates by nationality and education level.

**Table 2** Results of immigration employment rates.

| Native | Rates | |
|---|---|---|
| | **Men** | **Women** |
| Primary or less | 60 | 45 |
| Secondary | 73 | 70 |
| Post-Secondary | 79 | 78 |
| Primary or less | 50 | 40 |
| Secondary | 63 | 63 |
| Post-Secondary | 66 | 69 |

### *3.2. Highly Qualified Immigrants in the Workforce*

The employment quality of highly educated immigrants is investigate in this section based on factors including salary, professional skill level, and fit between education and work. According to the International Standard Classification of Occupations (ISCO), we divided professions into three categories: jobs with little skill (those requiring Skill Level 1), middle-skilled occupations (those requiring Skill Levels 2 and 3), and high-skilled occupations (those requiring Skill Level 4).

Figure 4 displays the yearly work income for immigrants who have been residents of Sweden for at least five years, broken down by educational attainment and gender. No of their level of education or gender, foreign-born people made less money than native-born people, as was to be anticipated. When compared to those with elementary education but larger when compared to people with secondary education, the salary disparity among highly educated immigrants and locals was comparable. Table 3 shows the results of job earnings of immigrants.

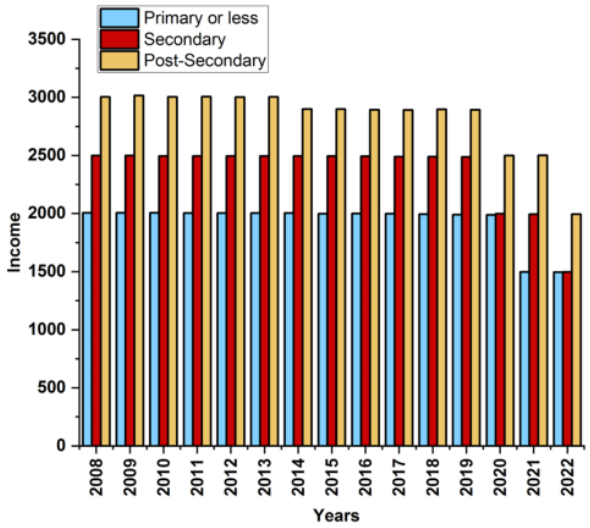


**Figure 4** Job earnings of working immigrants with advanced degrees by year of migration.

**Table 3** Results of job earnings of immigrants.

| Foreign-born | Income | | |
|---|---|---|---|
| | Primary or less | Secondary | Post-Secondary |
| Men | 2503 | 2900 | 3507 |
| Women | 2004 | 2400 | 3000 |
| Men | 3002 | 3400 | 4502 |
| Women | 2400 | 2505 | 3005 |

The foreign-born are probably less likely to experience this since they may have a higher need for women to help supplement their families' meager incomes. A similar tendency may be seen among those with less education. The gap in annual income between those who are native-born and those who are foreign-born is likely bigger for males than for women for the exact same reason as stated above.

In Sweden, we anticipate that the majority of employed males who are native or foreign-born work full-time. As a consequence, in the lack of information detailing the annual amount of hours worked, the difference between both of these groups is more precise. Figure 3 suggests that natives have greater advantages when it comes to education than immigrants if we focus on these two groups. In order to draw further conclusions about the potential causes fundamental this disparity, we need to look at the internal differences in income among foreign-born people by year of migration (Figure 4), as well as the levels of employment of highly educated immigrants contrasted to that of citizens (Figure 5, Tables 4 and 5).

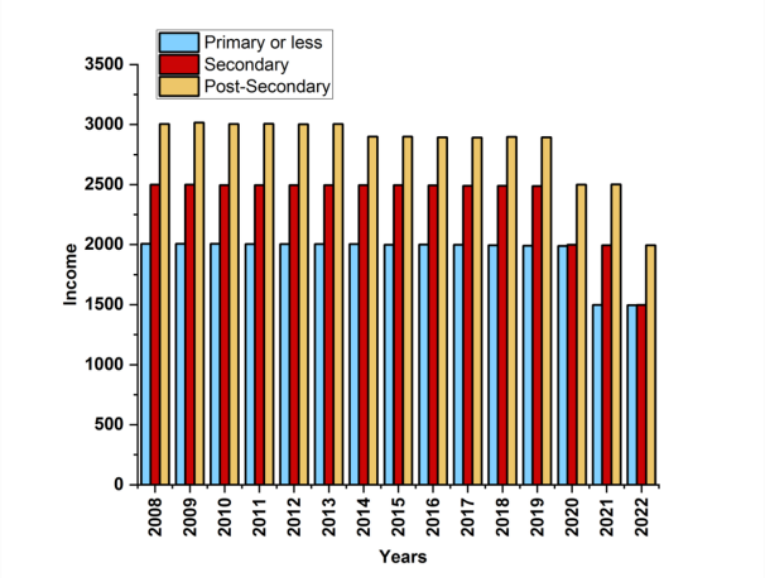


**Figure 4** Job earnings of working immigrants with advanced degrees by year of migration.

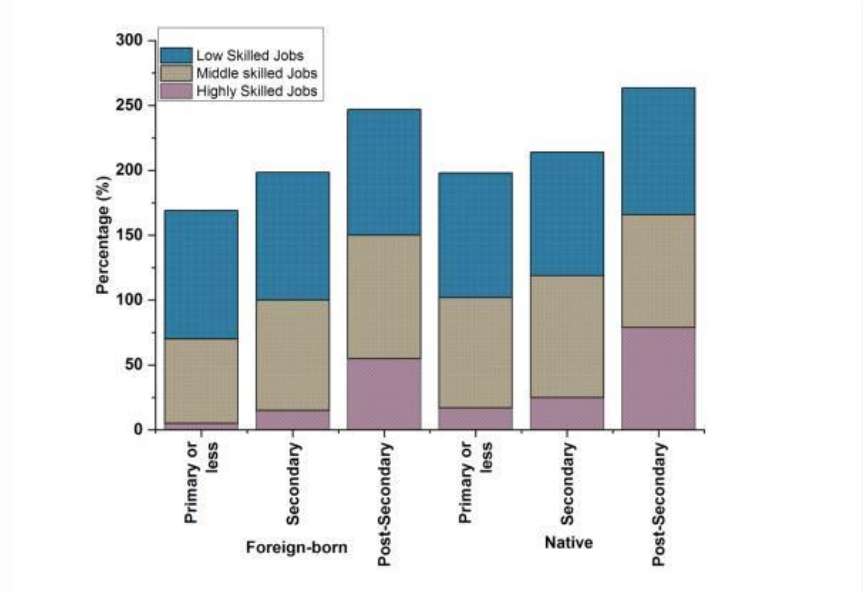


**Figure 5** Matching working immigrants' and locals' education to jobs.

**Table 4** Results of job earning of immigrants by degree.

| Years | Income | | |
|---|---|---|---|
| | **Primary or less** | **Secondary** | **Post-Secondary** |
| Before 2007 | 2502 | 2509 | 3499 |
| 2008 | 2006 | 2500 | 3005 |
| 2009 | 2006 | 2499 | 3016 |
| 2010 | 2006 | 2496 | 3005 |
| 2011 | 2005 | 2495 | 3007 |
| 2012 | 2005 | 2495 | 3003 |
| 2013 | 2005 | 2496 | 3004 |
| 2014 | 2004 | 2496 | 2900 |
| 2015 | 1999 | 2495 | 2899 |
| 2016 | 2001 | 2493 | 2894 |
| 2017 | 1998 | 2490 | 2891 |
| 2018 | 1994 | 2489 | 2898 |
| 2019 | 1992 | 2487 | 2894 |
| 2020 | 1990 | 1998 | 2499 |
| 2021 | 1499 | 1995 | 2502 |
| 2022 | 1496 | 1499 | 1995 |

The two extremes of Figure 5 show the most obvious graphical distinctions between the two groups, which may be summed up as follows: The percentage of native-born workers with advanced degrees is higher, whereas the proportion of immigrants with just primary education working in elementary professions is larger.

The return on schooling may be lower for immigrants who reside and work in Sweden than it is for locals, according to the findings thus far given in this section. The standard justifications used in the scientific literature to explain such disparities might also be used to explain this research, including prejudice against foreign-born people and inequalities in language proficiency and other human and social capital that are country-specific.

The last factor influencing the job chances for immigrants is the motivation for migrating, the method of admission into the nation of residence, and the results of all these factors. We look at the skill level of their professions by entrance channel and gender to wrap off our descriptive research on the standard job prospects of highly educated immigrants.

**Table 5** Results of Education to job match.

| Foreign-born | Percentage (%) | | |
|---|---|---|---|
| | **Low Skilled Jobs** | **Middle skilled Jobs** | **Highly Skilled Jobs** |
| Primary or less | 99 | 65 | 5 |
| Secondary | 98.5 | 85 | 15 |
| Post-Secondary | 97 | 95 | 55 |
| Primary or less | 96 | 85 | 17 |
| Secondary | 95 | 94 | 25 |
| Post-Secondary | 97.5 | 87 | 79 |

## 5. Conclusions

In conclusion, predicting income and immigration patterns is a crucial undertaking that may provide insightful information about societal and economic developments. Accurate prediction models for immigration and income dynamics may be created with the assistance of machine learning along with information analysis tools, such as the XG Boost algorithm, which is based on binary regression and uses swarm optimization. To prepare for changes in the labor market and economy, identify areas for development and investment, and forecast the number of immigrants approaching a nation or region, in addition to their social and demographic features, predictive models may be utilized. A potent machine learning method that is capable of handling high-dimensional data and choosing features is the Binary Regression-based XG Boost algorithm. It may autonomously choose the most crucial characteristics and lower the chance of overfitting, which enhances the model's generalization capabilities. The use of these methods may result in forecasts that are more precise and trustworthy, which can be used to guide policy, planning, and decision-making for a number of stakeholders.

## Ethical considerations

Not applicable.

## Declaration of interest

The authors declare no conflicts of interest.

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Improving feedback analysis: Deep learning approach to college customer satisfaction assessments

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**Abstract** Establishing consumers' views via text-based feedback in a questionnaire is crucial for organizations, include education, since it gives a summary of significant areas that help administrators plan, regulations, and decision making. Through surveys, academic organizations have gathered huge quantities of textual data all over the years. For the organization, it is still difficult to analyse the vast quantities of unstructured feedback from customers to understand their concerns and opinions generally. In this study, we propose deep learning (DL) based technique called topic modelling that utilizing Naive Bayesian (NB) to automatically summarize text and retrieve ideas from this raw data. Additionally, it discusses the text mining procedure used to extract relevant information from the vast volume of text-based data. The most significant issues obtained through feedback from customers were subsequently identified. The findings showed particular issues for workplaces, including environment, staffing, IT infrastructure, and customer feedback system. The feedbacks also prominently highlight difficulties with the attitude of student assistance and security staff as well as the library's management and operations.

**Keywords:** deep learning, Naive Bayesian, topic modelling, customer satisfaction

## 1. Introduction

Higher education institutions must prioritize student happiness. Maintaining a healthy learning environment, enhancing educational results, and drawing in new students depend on assessing and comprehending the satisfaction levels of students and other stakeholders within the college ecosystem (Qutieshat et al 2020). To learn more about student happiness, universities have traditionally used surveys, ways to provide feedback and assessments. But presumptions, small sample numbers, and laborious data processing procedures often plague these approaches. As machine learning technology develops, there is a chance to use it to increase and simplify the assessment of college student happiness.

A critical component of every organization, including schools and universities, is customer satisfaction measurement. Machine learning algorithms have seen a considerable change in recent years in analysing consumer feedback and gauging client happiness (Dash et al 2021).

Machine learning, an aspect of machine learning, concentrates on training neural networks with numerous layers to discover intricate patterns and representations from big datasets. In a number of fields, including voice recognition, picture recognition, and natural language processing, this method has shown astounding performance. We can extract valuable insights from enormous volumes of data by using machine learning methods to the assessment of college customer satisfaction. This would enable schools to make data-driven choices to enhance students' experiences and institutional performance (Asghar et al 2021).

This strategy may assist universities in identifying locations where patrons are expressing unfavourable opinions, enabling administrators to take remedial action to raise patron contentment. The modelling of a topic is another kind of machine learning that is used for evaluating customer happiness. In topic modelling, algorithms find recurring themes or subjects in a vast dataset. This method enables universities to pinpoint the most important aspects that impact student happiness and concentrate their efforts there (Capuano et al 2021).

The main goal of this study is to create a machine-learning model capable of reliably predicting and evaluating college consumer happiness. To find trends, correlations, and predictors of satisfaction levels, the model will be generated on the data that have been gathered. We may learn more about the important areas where schools can concentrate their efforts to increase customer satisfaction by examining the model's findings (Özkan et al 2020).

In this regard, machine learning algorithms provide a potential method for analyzing customer feedback and measuring customer satisfaction in schools and universities. Colleges may improve the entire customer experience by using these strategies to acquire insightful information about consumer sentiment and pinpoint areas that need improvement (Ibrahim et al 2019).

The data gathered from this study (Ho et al 2021). Suggest that higher education institutions should place a high priority on supporting and enhancing initiatives made by instructors, modulating assessment procedures to enhance the workload, suitability, and impartiality for unforeseen modifications using ERL during a crisis, developing contingency strategies and other complementary educational activities or assets to compensate for the inferiority, or learning deficiencies in ERL.

An algorithm for text analysis of consumer feedback was developed in study (Soriano and

(Palaoag 2018) using machine learning techniques like topic modelling. This went on to detail the methods used throughout the text to perform mining to extract meaningful data from the customer survey feedback of Bicol State College of Applied Sciences and Technology (BISCAST), one of the SUCs in the Philippines Additionally, automatic text synthesis and theme extract from the information sources based on texts were completed. The major issues that emerged from the input were noted. Both inputs for policymaking and helpful insights for management analysis are provided by this information.

The study of the author (Shambour 2021) suggested a machine learning-based approach for multi-criteria recommender systems. An algorithm describes the irregular and complicated user-item correlations. To improve the sources and learn the delicate user-item connections, an extensive auto encoder-based multicriteria suggestion algorithm was generated. It enables the coding of more combined definitions as data representations in the more advanced layers, in addition to the multicriteria preferences of customers.

The study (Almuqren et al 2019) uses an analysis of sentiment which utilizes a corpus of Arabic tweets, to determine customer happiness for Saudi telecom organizations. According to the study's findings, the bidirectional-GRU with method of attention performed better in the telecommunications sector and enabled very accurate customer satisfaction detection in that area.

The study (Ligiarta and Ruldeviyani 2022) used Support Vector Machine (SVM) model established to predict the sentiment of the obtained data, which might be favourable or adverse. According to the model training results, this model has an accuracy rate of 92.5%. Using sentiment analysis on BCA Mobile, Livin' by Mandiri, BRI Mobile (Brimo), and BNI Mobile, the study examines consumer happiness.

The purpose of the research (Nwachukwu 2023) was to analyses the impact of artificial intelligence (AI) advertisements on consumer satisfaction. When analyzing the data, the Pearson Moment regression coefficient and the SPSS spreadsheet were used. The important rising correlation parameters with subsequent orders and customer referrals prove that artificial customization has a considerable optimistic link with customer happiness.

The study of the research (Aslam et al 2019) investigates the relationship between customer satisfaction and automated teller machine (ATM) service quality. Investigative factor analysis (EFA), confirmatory factor analysis (CFA), and structural equation modelling (SEM) were implemented to discover the aspects of the quality of ATM services and their associations with customer satisfaction and regard for others. In this research outlines the problems that need to be fixed to elevate the quality of ATM service and offers specific recommendations for bank management to enhance customer satisfaction with ATMs.

They suggested a method for simulating consumer happiness using data from internet reviews in (Bi et al 2019). The process begins by applying naive bayesian algorithm allocation to extract customer satisfaction dimensions (CSDs) from online reviews. An SVM was used to calculate the sentiment orientations of the obtained CSDs. (SVM). Then, a collective neural network-based typical (ENNM) was presented to quantify the impacts of consumer opinions toward various CSDs on customer happiness, considering complicated interactions between various CSDs and customer satisfaction. Finally, a case study was carried out to demonstrate the viability of the suggested approach.

Authors of study (Zhou et al 2020) analyzed many online user-generated assessments of products inside a product ecosystem to offer a machine-learning method for customer requirements analysis. They implemented a rule-based appraisal technique to forecast the reviews' sentiment and sentiment intensity ratings. Finally, focusing on the dissatisfaction-satisfaction ratio from the perspective analysis, they categorized customer needs relating to numerous themes using an analytical Kano model.

Aim: In this paper, they offer a topic modeling approach that uses Naive Bayesian (NB) algorithms to summarize text and recover concepts from this unprocessed information. The text mining process used to sift through a large amount of text-based data and find pertinent information is also covered.

## 2. Materials and Methods

To examine client problems gleaned from their text-based comments and recommendations from the feedback form, an analytical approach was used in this study. Additionally, this study made use of text-mining techniques. Data mining includes text mining, which aims to automatically uncover intriguing and complex configurations from unorganized textual

data. Figure 1 depicts the text extraction procedure flow, which starts with data collection from different sources, followed by pre-processing, text mining method applied on the cleaned data analysis, evaluation, and interpretation of the results.

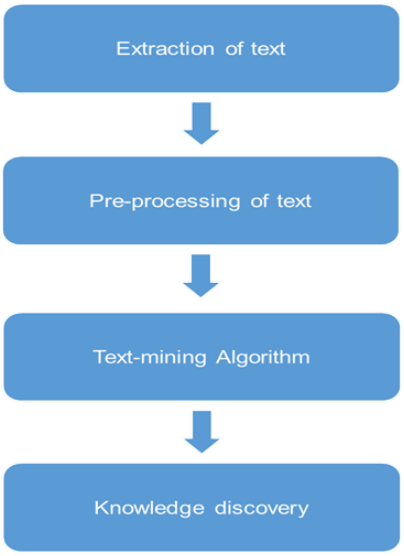


**Figure 1** Text data mining process flow.

*2.1. Extraction of Text*

The informational resource of the state college's customer satisfaction assessment system was used to obtain data for the 2021–2022 academic year for this research. The school's various constituents, which include students, staff, and customers from the outside, are conducting the purpose of this study. Their criticism, improvement requests, and opinions were removed from the database.

*2.2. Pre-processing of text*

Pre-processing is a crucial and significant step in the text mining process previously using any text mining techniques. In this step, the corpus was cleaned to reduce, if not eliminate, imposed terms and defects in consistency present in the text. For the purpose of creating a usable domain model, data cleansing is vitally essential. The content was normalized by removing words that ended in punctuation, preceding and utilizing trailing whitespaces, and other formatting elements. The text was also changed to be lowercase, subsequent whitespaces were compressed, and stemmed words were added.

Data purification was first carried out manually. Misspelled words were fixed, joyful expression indicators were eliminated, "ok" and "ty" phrases were dropped, and terms from the regional dialect were transformed into formal English. The cleansing procedure was then finished using OpenRefine, an open-source program for data purification and layouts modification.

*2.3. Text-mining Algorithm*

Naive Bayes is a probabilistic classification algorithm that is commonly used in text mining for tasks such as document classification, sentiment analysis, spam filtering, and more. The algorithm is based on Bayes' theorem, which is a way of calculating conditional probabilities. In text mining, Naive Bayes works by analysing the frequency of words in a document or a set of documents and using this information to predict the class of a new document.

The basic theory behind the technique is that documents comprise various hidden themes, with the possibility of the characters given to each subject. These subject probabilities provide a succinct summary of a text.

Naive Bayes is a prominent text mining technique since it is quite simple and effective, particularly when working with huge datasets. However, in certain circumstances, its exactitude may be constrained by its feature independence assumption. Additionally, the algorithm's accuracy depends on how well the feature extraction procedure was done.

**3. Discussion and Result**

*3.1. Techniques for Data Processing*

The statistics were obtained for the academic year 2021–2022 from the state college customer satisfaction survey (CSS) database.

The 500 entries made up the majority of the dataset. Pre-processing procedures were applied to the extracted data to eliminate noise and inefficiencies. The elimination of the preceding and following whitespaces, punctuation, symbols,

unimportant but often reaffirmed words, and stop words is one of them. Other methods include grouping terms and word stemming. The dataset is now ready for further processing. After maintenance, the corpus was reduced to 475 records.

*3.2. Topic Models*

To produce topics or themes that appeared in the customer feedback, the Mallet with naive bayesian algorithm was utilized.

The original values for the parameters were 1500, 20, and 20, respectively, for the number of iterations, themes, and top words. It was discovered after studying the subject composition breakdown that similar terms fell under several themes. This indicates that the context is too wide and should be made more focused by fewer themes and more top words. As a result, the top 8 words were increased, and the number of themes was reduced from 5 to 15. In Figure 2, the list of produced subjects is shown.

| | | |
|---|---|---|
| 0 | 0.09856 | Facilities survey system online improve provide confidentiality waiting area additional skills appreciated feedback truthful id-card create payment specially eliminate bias |
| 1 | 0.03315 | fine office location air-condition change ventilation poor restructure additional appliance comfortable structure properly provide organize |
| 2 | 0.02891 | Customer satisfying smiling service good efficient quality job satisfied excellent work professional optimistic nice office |
| 3 | 0.03378 | Regular staff personnel approachable employee accommodating additional improve helpful permanent kind hire fast friendly employ |
| 4 | 0.04192 | Maintain nice assistant friendly student training security guard offered cleanliness well-trained surroundings improve training easily |

**Figure 2** list of generated topics.

Each line in the picture has three elements: the subject number, the topic weight, and the phrases that follow, which are the words that are related to that topic and are used the most often.

The initial component on each line of the figure is the subject number, the subsequent component is the topic's weight, and the phrases that execute are the terms that are used the most often and come under that topic.

*3.3. Procedure for Validation and Assessment*

Authorities in the relevant fields are consulted as part of the validation process for the created subject models. The Director of Student Development Services, the Institutional Planning Officer, and the Vice President for the College of Education made up the group of specialists. They were asked to go through the vocabulary associated with each subject and determine what each set's overarching theme was. Table 1 summarizes three themes from the dataset that were randomly selected, along with the top terms and their weight.

The professionals have categorized the subject models taken from the comments after carefully examine groupings of words from each topic. Figure 3 contains a list of the recognized key topics. The experts have categorized the subject models taken from the comments after carefully examining groupings of words from each topic. Figure 3 contains a list of the recognized key topics.

| Topic No. | Main Topic/ Theme | Top Words |
|---|---|---|
| 0 | Customer Feedback System | Facilities survey system online improve provide confidentiality waiting area additional skills appreciated feedback truthful id-card create payment specially eliminate bias |
| 1 | Office Environment | Fine office location air-condition change ventilation poor restructure additional appliance comfortable structure properly provide organize |
| 2 | Customer Service Quality | Customer satisfying smiling service good efficient quality job satisfied excellent work professional optimistic nice office |
| 3 | Office Staffing | Regular staff personnel approachable employee accommodating additional improve helpful permanent kind hire fast friendly employ |
| 4 | Security Personnel and Student Assistant Attitude | Maintain nice assistant friendly student training security guard offered cleanliness well-trained surroundings improve training easily |

**Figure 3** Labeled Topic Models

On the contrary, the evaluation procedure involved using the trained algorithm to deduce new collections of documents and manually analyzing the topic assignments when the model properly predicted the subject. The outcome of the prediction conduct applied to the newly acquired document work is shown in figure 4.

| # doc | New Text Data | Customer Feedback System | office Environment | Customer Service Quality | Office Staffing | Security Personnel and Student Assistant Attitude |
|---|---|---|---|---|---|---|
| 0 | maintain office cleanliness | 0% | 98% | 0% | 0% | 0% |
| 1 | lack of employee | 0% | 26% | 0% | 77% | 0% |
| 2 | improve building facilities | 0% | 73% | 0% | 9% | 0% |
| 3 | continue what you are doing, excellent service | 0% | 0% | 99% | 0% | 0% |
| 4 | very accommodating | 0% | 2% | 86% | 14% | 0% |
| 5 | some monitor are not working well | 5% | 15% | 3% | 9% | 4% |
| 6 | install air-condition | 0% | 93% | 0% | 3% | 0% |
| 7 | Add staff | 0% | 2% | 0% | 98% | 0% |

**Figure 4** The distribution of topics in a new document using probability.

The initial document work, mostly defined by the office setting, demonstrates that the model successfully anticipated the themes of future documents. Additionally, the third and fourth documents discuss customer service excellence.

### *3.4. Primary Client Concerns*

After analyzing the feedback from the database of the customer satisfaction survey system, the top customer complaints were identified and arranged by composition, as shown in Table 2.

**Table 1** Top 5 Words from 3 Topics.

| Topic 3 | | Topic 1 | | Topic 0 | |
|---|---|---|---|---|---|
| regular | 6.38 | Fine | 4.32 | facilities | 3.11 |
| staff | 59.45 | Office | 31.27 | survey | 15.26 |
| personnel | 32.18 | Location | 41.13 | system | 7.12 |
| approachable | 41.23 | Air-condition | 19.85 | online | 12.23 |
| employee | 11.19 | Change | 8.15 | improve | 7.17 |

**Table 2** Top 5 Customer Concerns.

| Rank | Main Topic/ Theme | Weight |
|---|---|---|
| 1 | Office IT System | 0.789 |
| 2 | Office Environment | 0.547 |
| 3 | Office Staffing | 0.836 |
| 4 | Customer Service Quality | 0.213 |
| 5 | Customer Feedback System | 0.452 |

According to the outcome, respondents' top worry is the level of customer service. Given that the study is focused on customer pleasure, this is to be anticipated. Additional office-related issues, including employees, the atmosphere, a mechanism for collecting client feedback, and an IT system, were subsequently found. Additionally, difficulties with the attitude of the security staff and student assistants, as well as library administration and management, are mentioned in the feedback.

Following that, these were given to the administrators as inputs for decision- and policy-making. This is because one of the recommendations in the ISO audit findings for the school was the reorganization and clustering of customer feedback to see their overall perception and to prioritize and concentrate on the necessary actions.

## 5. Conclusion

In this work, the researcher described how an algorithm based on machine learning was implemented to assess and identify the top issues from customer feedback that was left unstructured. According to the research, topic modelling using a Naïve Bayesian algorithm successfully located the main topics in the client assessments of the state college. The findings, which are thought to be helpful in making judgments and establishing school rules, were presented to school leaders. It also addressed the remarks and suggestions regarding the state college's use of consumer feedback in the ISO audit results. To acquire a comprehensive understanding of the customer perspectives and issues, the researcher advises using the same

methodology for additional text-based surveys that the institution conducts. The school could also consider using an online survey method to get more people to provide honest feedback.

### Ethical considerations

Not applicable.

### Declaration of interest

The authors declare no conflicts of interest.

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Hybrid deep learning model for flood frequency assessment and flood forecasting

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**Abstract** The most common and persistent natural hazard to people across the globe is flooding. The frequency of floods in a given place is defined as the likelihood and intensity of floods occurring there within a certain period. Examining historical flood data and using techniques are often used to determine the likelihood that a flood of a certain size would occur in a specific location. The method of flood prediction involves making forecasts on the frequency and severity of flooding. It may be influenced by a number of factors, including the topography, river flow, soil moisture content, and the period of rainfall. In this research, we provide a novel Cat Swarm Optimized Spatial Adversarial Network (CSO-SAN) technique for predicting and assessing flood frequency. This technique simulates the yearly greatest flow at the river Mahanadi measurement sites at Andhiyarkore, Bamanidhi, Baronda, and Kurubhatta over 60 years. The CSO-SAN model is adapted for the flood forecasting component to predict the frequency and size of future floods. The model incorporates real-time data from various sources, such as meteorological predictions and information on river flow, to anticipate the probability and severity of upcoming floods. Compared to other conventional statistical techniques and forecasting models, the CSO-SAN model outperformed them in tests conducted on the Mahanadi river basins. The model offers a viable method for improving the precision of flood frequency evaluation and flood forecasting, with significant advantages for managing and reducing flood risk.

**Keywords:** deep learning, flood frequency, floods forecasting, CSO-SAN

## 1. Introduction

As one of the most devastating natural hazards, flooding has a negative effect on both the health of populations and their financial well-being. Efficient flood prevention is urgently needed since severe weather conditions have raised in many places of the globe, probably due to shifts in climate scenarios (Dong et al 2020). A reliable and successful method for flood forecasting is a key component of planning and controlling flood occurrence. A reliable long-term flood forecasting model produces the smallest amount of inaccuracy, which also enables decision-making on optimal reservoir management to maximize operating efficiencies and the lowest amount of flood hazards and provides enough time for creating an appropriate disaster mitigation plan (Alipour et al 2020). A structured procedure for developing flood maps has been made in the European Union (EU) as a result of the EU Flood Directive (2007/60/EC), which is specific about what types of floods, what flood features, and how often flooding ought to be assessed when evaluating the risk of flooding. The EU is becoming more interested in flooding that results directly from heavy rainfall, often called pluvial floods, due to an increase in natural catastrophes (David and Schmalz 2020).

Additionally, pluvial floods have recently been simulated by combined hydrological-hydraulic techniques using rain-on-grid addressing with time-dependent 2-dimensional models due to a highly interrelated rainfall-runoff process, rapid advancements in mathematical technology, and the accessibility of excellent quality topographic data. However, due to the absence of actual data necessary to validate models, it is still challenging to provide an accurate flood forecast in tiny ungauged basins (Annis et al 2020). Human activities greatly impact the environment as society and the economy advance. Due to its naturally fragile ecosystem and susceptibility to long-term improper human activity, the loess area experiences significant loss of water and soil erosion. The loess area has developed into a site regularly endangered by flash flood catastrophes due to complicated topographical and geological characteristics and frequent storm drains (Anaraki et al 2021). This has caused a lot of academic curiosity since storm flooding in the Loess region is very common and precise.

The constraints of traditional flood frequency analysis and forecasting techniques include the presumption of stable data and the incapability to capture intricate nonlinear interactions. The Deep Learning (DL) model has been suggested for flood frequency assessments and forecasting to overcome these constraints. To increase the efficacy and accuracy of flood prediction, the model combines the benefits of both DL and conventional techniques (Samantaray et al 2021). Hybrid DL

algorithms can precisely and quickly anticipate flood occurrences by concurrently examining different data sources. By examining real-time data from sensing and social media feeds to pinpoint regions of need and organize rescue activities, hybrid deep learning models may help with disaster response and making predictions. To locate damaged regions and gauge the success of relief activities, they may also assist with following disaster reconstruction efforts by examining satellite images (Ren et al 2019).

(Zanchetta and Coulibaly 2020) summarized and analyzed recent developments in understanding the environmental variables that precede severe rainfall events, developing monitoring systems for pertinent hydro meteorological variables, and operationalizing weather and hydrological simulations for the forecasting of flash floods. Most study has concentrated on developing techniques for data from multiple sources, assimilation, and integration, and putting together strategies for uncertainty assessments because there has been exponential growth in data availability and computing capacity. The rainfall criterion may significantly reduce the computational complexity of anticipating floods using a data-driven method. (Ke et al 2020) employed a rainfall criterion for identifying flood vs. non-flood occurrences based on Machine Learning (ML) methodologies, applied to an instance of Shenzhen city in China, to prepare the communities against regular pluvial flood events, particularly in a changing environment. Increasing atmospheric temperatures have caused a drop in Eastern Hemlock (EH) in the Northeastern United States, which has led to an increase in the water supply of the watershed. (Knighton et al 2019) assessed the likelihood that a shift in the flooding regime would result from an EH loss. Using stable isotope measurements of stream, soil, and plant xylem water, they first examined how the root system regulates plant hydraulics in EH and American Beech. (Sit and Demir 2019) aimed to investigate how well Artificial Deep Neural Networks (ADNN) anticipates floods. The research offers a dataset that focuses on the connection of measurements on river systems but offers algorithms that may be used to anticipate the stream stage. Additionally, it demonstrates how neural networks may improve current models by incorporating data and be particularly beneficial in time-series prediction, such as in flood disasters.

(Ding et al 2020) discussed the necessity for flood forecasting, and an understandable Spatio-Temporal Attention Long Short-Term Memory model (STA-LSTM) based on LSTM and attention mechanisms were proposed. They built the model using LSTM and flexible attention mechanisms, normalized the data using the Max-Min approach, chose the hyper parameters using the variable management method, and then trained the models using the Adam algorithm. To forecast severe flooding in a tiny highland watershed with varied lead times, (Wu et al 2019) suggested a powerful artificial intelligence-based model called a Support Vector Regression (SVR) model created from the idea of statistical learning. The physiological concept of reaction time establishes the delays associated with the algorithm's input factors. The equation accepts the postponed average amounts of rainfall and runoff as input parameters. In a hilly watershed in China, 69 flash flood occurrences were gathered from 1984 to 2012 and utilized for model training and evaluation. Quantitative Precipitation Forecasts (QPFs) based on longer-term mathematical weather forecasts or short-term infrared extensions are used for actual time flood forecasting is one of the more effective methods in this respect. They created a novel real-time mixing strategy in (Yoon 2019), to increase the precision of rainfall predictions for hydrological purposes. Each method has unique benefits and drawbacks. They examined the hydrologic application of six QPFs utilized in Seoul, South Korea, for predicting urban flooding. The Long Short-Term Memory (LSTM) neural network was used in (Liu et al 2020), to model rainfall-runoff correlations for catchments with various climatic variables. Several streams in China with different climatic zones were used to evaluate the LSTM approach. To confirm the LSTM model's superiority in terms of historical prediction issues, the Recurrent Neural Network (RNN) was chosen for evaluation. To assess the viability of this new approach, the outcomes of LSTM were also contrasted with those of the Xinanjiang model (XAJ), a popular process-based model. In this study, we present a novel Cat Swarm Optimized Spatial Adversarial Network (CSO-SAN) technique for calculating the frequency of flooding and executing flood forecasting.

### *1.1. Problem statement*

For authorities to plan for and lessen the effects of flood occurrences, flood frequency assessments, and floods are essential for flood management. However, since hydrological systems are intricate and dynamic, it may be difficult to determine the frequency of flooding and estimate when it will occur. The absence of precise and current data on hydrological factors, including rainfall, river flow, and soil moisture, is one of the major obstacles in assessing flood frequency. As a result, estimating the frequency of flood episodes and precisely modeling their likelihood are challenging tasks. The 'creeping' and sneaky character of flood outbreaks makes it difficult to create reliable systems to send prompt flood alerts. This is because designing early warning systems involves knowledge of several technologies. It seems sense that such an issue might pose a greater problem for underdeveloped countries like Fiji. For this reason, an economical solution with a low investment need for such technologies is preferred for flood forecasting. The novel Cat Swarm will solve these issues Optimized Spatial Adversarial Network (CSO-SAN) flood modeling approach that this study presents.

The other sections of the article are as follows: section 2 discusses methodology, section 3 discusses findings, and the last section gives the conclusion.

## 2. Materials and Methods

In this paper, a hybrid model called CSO-SAN is proposed to forecast the rising potential of a flood channel network using information obtained from sensors that measure flooding. CSO-SAN was the one that we decided to go with because of its shorter training periods, lower prediction costs, and increased prediction accuracy.

*2.1. Dataset*

The Mahanadi River is a large peninsular river that flows east in eastern-central India. It has a total size of 1, 41, 589 km and is separated into the delta, center, and upper areas. It makes up around 4.3% of India's total land area, with most of the basin being in Odisha and Chhattisgarh. Before reaching the Bay of Bengal, the river traverses the remaining portion of the regions of Jharkhand, Maharashtra, and Madhya Pradesh. Near the hamlet of Pharsiya in Raipur, Chhattisgarh, the Mahanadi begins at an elevation of around 442 meters above mean sea level. The distance from its origin to where it converges at the Bay of Bengal is about 851 km, of which 357 kilometers are in Chhattisgarh, and 494 km are in Odisha. It is between coordinates 19o20' and 23o35' N and longitudes 80o30' to 86o50' E. The subtropical climate of this area has maximum temperatures of approximately 45°C in May and lowest temperatures of about four °C in winter from December to January. During the monsoon season, which lasts from June to October, the average annual rainfall is 1200 mm. Over the Mahanadi basin, the amount of rainfall is unequal. As shown in Figure 1, the gauging sites in Andhiyarkore, Bamanidhi, Baronda, and Kurubhatta are where the present research is being carried out (Sahoo et al 2019). Natural occurrences like high rain during the monsoon, notably in the basin's upper region, which almost generally occurs every two to three years, generate overbank flow, leading to severe floods. The monsoonal months of May to October, from 1960 to 2019, were the period for which each month's floodwater discharge was gathered from IMD, Raipur, and Chhattisgarh, India.

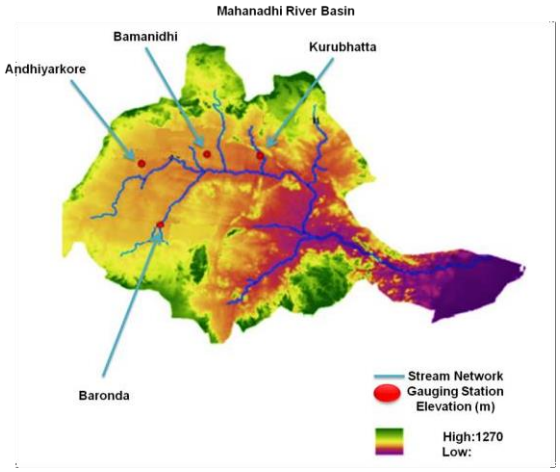


**Figure 1** Proposed field of research.

*2.2. Cat Swarm Optimization (CSO)*

Cat Swarm Optimization (CSO) may be used to estimate flood frequency and anticipate floods by enhancing the parameters of mathematical models that express the likelihood of flood occurrences.

The Log-Pearson Type III (LPIII) distribution, often used to simulate the likelihood of flood episodes, may have its parameters optimized using CSO, for instance, in evaluating flood frequency. The subsequent expression describes the LPIII distributions:

$$F(x) = 1 - (1 - P)^T \qquad (1)$$

Where T, the return time, is the typical number of years among floods of similar or larger size, P is the exceedance possibility of the flood, and F(x), is the total distribution function of flood magnitude x.

The location variable$(\mu)$, scale variable$(\sigma)$, and shape variable$(\gamma)$ of the LPIII distribution may all be optimized using the CSO method. CSO may increase the accuracy of the flood frequency prediction model by determining the ideal parameter values that best suit the existing data.

Similarly, CSO may be utilized in flood forecasting to improve the weights and biases of neural networks for predicting upcoming flood occurrences. The formula that follows may be employed when representing a neural network:

.

$$y = f(W_{x+b}) \qquad (2)$$

Where W is the weight matrix, b is the bias vector, f is the activation function, y is the anticipated flood size, and x is the input data (for example, rainfall river flow).

By reducing the difference between the predicted and actual flood occurrences, the CSO method may improve the neural network's weights and biases. CSO may increase the efficacy of the flood forecasting system by determining the ideal weights and biases values.

### *2.2. Spatial Adversarial Network (SAN)*

Spatial Adversarial Networks (SANs) are a sort of deep learning architecture that may be used for flood frequency evaluation and prediction by creating synthetic flood data and increasing the accuracy of predictive models. This can be accomplished using SAN ability to improve the quality of predicting systems.

The generator network and a network of discriminators comprise the two primary parts of SAN. Simulated flood data produced by the generator network is supplied into the discriminator network with actual flood data. The discriminator network has been trained to differentiate between actual and false flood data. The generator network is then upgraded to provide more accurate flood data. The procedure is continued until there is no difference between the created and actual flood data.

The deep neural network (DNN) is a form of neural network composed exclusively of direct and inverted convolutional layers. In essence, neural networks combine many ''neurons'' or processing units to calculate the (sometimes complicated) correlations among input, x, and output, y, data vectors. The traditional DNN design also stacks additional layers of neurons. The neuron's usual expression is provided by

$$g(y) = e(\langle y, z \rangle + a) \qquad (3)$$

Where $g(.)$ stands for the neuron's scalar output, and $e(.)$ is a recognized quadratic expression as the "activation function," $\langle .,. \rangle$ stands for the exponential outcome, $z = [z_1, \dots, z_M]$ is a group of masses with the same number of dimensions M as y, and a is the bias related to the neuron. A DNN has to be ''learned'' or taught to be helpful. Every neuron has its own adjusted z and parameters. Throughout learning so the DNN can carry out a particular job as effectively as feasible. The descent of gradients can maximize z and a when $e(.)$ is distinguishable. The rectified linear unit (ReLU), sigmoid function, and hyperbolic tangent function are examples of common $e(.)$ forms.

SAN can produce artificial flood data that accurately mimics the geographic patterns of flood occurrences. This may be especially helpful when historical data are absent or when the data that is available does not accurately reflect current or projected flood trends.

The convolutional layer is the main component of the Convolutional Neural Network (CNN) architecture. Due to the convolutional operator's explicit consideration of the spatial arrangement in the input data, it has been widely used to estimate flood frequency. The convolutional layer, h, is created using a succession of k=1 when the input data is a 2-D picture;

$$g^{l}_{v,u}(Y_{v,u}) = e\left(\sum_{j=1}^{M_j} \sum_{i=1}^{M_i} Z^{l}_{j,i} Y_{v} + j, u + i + a_{l}\right) \qquad (4)$$

During flood frequency, SAN may be used to create artificial flood data added to the existing data to increase the precision of statistical models like the LPIII distribution. By doing so, you may lessen the uncertainty around the available data and help the flood frequency estimation algorithm become more accurate.

To train neural networks to anticipate future flood occurrences, SAN may be used to create artificial flood data. This may aid in boosting the flood forecasting model's accuracy, especially when historical data are absent, or the available data does not accurately reflect current or potential flood trends. SAN is a potential method for estimating flood frequency and predicting floods that may assist in increasing the precision and dependability of predictive models. By combining it with additional strategies like Cat Swarm Optimization or assimilation of approaches, its efficacy may be further increased.

### *2.3. Cat Swarm Optimized Spatial Adversarial Network (CSO-SAN)*

For the evaluation and forecasting of flood frequency, the Cat Swarm Optimized Spatial Adversarial Network (CSO-SAN) is a hybrid deep learning system that combines Cat Swarm Optimization (CSO) with Spatial Adversarial Network (SAN).

The following equations may be used to describe the CSO-SAN algorithm:

Generator network:

$$z \sim p(z) \qquad (5)$$

$$x' = G(z) \qquad (6)$$

G is the generator network improved through CSO, z is a random noise vector, and p(z) is a probability distribution function.

Network discriminator:

$$y = D(x) \qquad (7)$$

$$y' = D(x') \qquad (8)$$

Where y and y' are the outputs of the discriminator network for the actual and synthetic flood data, respectively, and D is the discriminator network that is improved via CSO.

In summary, the CSO-SAN strategy shows promise for enhancing models for estimating flood frequency and predicting floods. By combining it with additional strategies like physical-based models or data assimilation techniques, its efficacy may be further increased.

## 3. Results

This section examines the efficacy of various models for predicting floods in the Mahanadi River, including Deep Convolutional Neural Network (DCNN) (Guo et al 2021), Long Short-Term Memory (LSTM) (Le et al 2019), Fully Convolutional Network (FCN) (Nemni et al 2020), and the proposed Cat Swarm Optimized Spatial Adversarial Network (CSO-SAN) model. The classifier output may be stated as follows in the framework of the CSO-SAN approach for calculating flood frequency and flood forecasting: True Positive (TP), True Negative (TN), False Positive (FP) and False Negative (FN). These four categories assess the accuracy, precision, recall, and f1-measure of the approaches above, including the CSO-SAN method. To increase the precision and dependability of the model's predictions, the objective is to maximize the number of true positives and negatives while decreasing the number of false positives and false negatives.

### *3.1. Accuracy*

The effectiveness of models for calculating flood frequency and flood forecasting is often assessed using the measure of accuracy. It calculates the model's accuracy as a percentage of the total number of predictions.

$$Accuracy = \frac{(TP+TN)}{TP+TN+FP+FN} \qquad (9)$$

Figure 2 and Table 1 compare the suggested CSO-SAN method's accuracy with other flood forecasting techniques. The findings show that the CSO-SAN approach is more accurate than the current methods.

**Table 1** Accuracy outcomes with different techniques.

| Methods | Accuracy (%) |
|---|---|
| DCNN | 91.5 |
| LSTM | 92 |
| FCN | 94 |
| CSO-SAN [Proposed] | 98.3 |

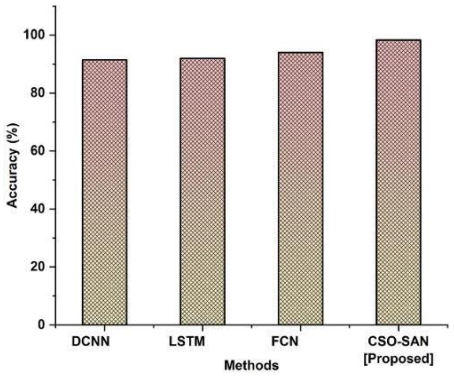


**Figure 2** Comparative Analysis of Accuracy.

### *3.2. Precision*

Precision is a measure of how well the approach predicts floods. With fewer false positive predictions (FP) and a high accuracy score, the model properly predicts the presence of floods in most of its positive predictions.

$$Precision = \frac{TP}{TP+FP} \qquad (10)$$

Figure 3 and Table 2 compare the suggested CSO-SAN method's precision with other flood forecasting techniques. The findings show that the CSO-SAN approach is more precise than the current methods.

**Table 2** Precision outcomes with different techniques.

| Methods | Precision (%) |
|---|---|
| DCNN | 80.3 |
| LSTM | 85.4 |
| FCN | 89.8 |
| CSO-SAN [Proposed] | 91.4 |

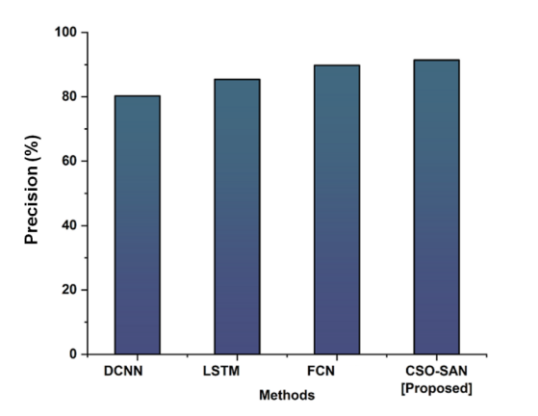


**Figure 3** Comparative Analysis of Precision.

*3.3. Recall*

Recall, commonly called sensitivity or true positive rate, is a performance statistic utilized in binary classification issues like flood frequency estimation and flood forecasting. It assesses the model's capacity to accurately detect all positive situations: the frequency of flood events.

$$Recall = \frac{TP}{TP+FN} \qquad (11)$$

The recall of the proposed CSO-SAN approach is compared with conventional flood forecasting methods in Figure 4 and Table 3. The results demonstrate that the CSO-SAN technique is more effective than the current methods.

**Table 3** Recall outcomes with different techniques.

| Dataset | Recall (%) | | | |
|---|---|---|---|---|
| | DCNN | LSTM | FCN | CSO-SAN [Proposed] |
| 0 | 65 | 69 | 80 | 90 |
| 1 | 69 | 71 | 83 | 92 |
| 2 | 67 | 73 | 85 | 94 |
| 3 | 65 | 75 | 87 | 96 |
| 4 | 68 | 77 | 89 | 98 |

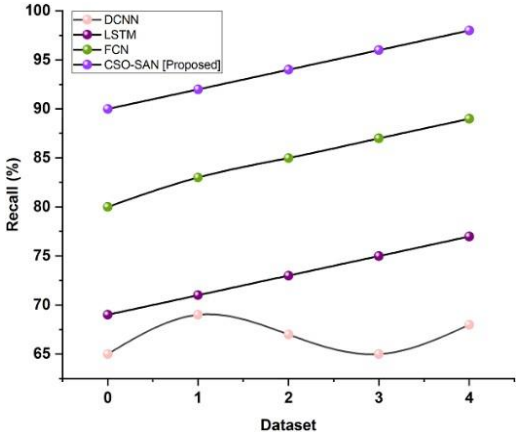


**Figure 4** Comparative Analysis of Recall.

### *3.4. F1-measure*

The F1 measure is a helpful indicator since it strikes a compromise between recall and accuracy. It may be crucial in datasets with imbalances where one class is much more prevalent than the other. The accuracy and recall of the classification are weighted fundamental means, and the F1-measure is defined as:

$$F1 - measure = \frac{2XPrecision\ X\ Recall}{Precision + Recall} \qquad (12)$$

The recommended CSO-SAN method F1-measure is contrasted with existing flood forecasting methods in Figure 5 and Table 4. The results demonstrate that the CSO-SAN strategy is superior to the other existing approaches in accuracy.

**Table 4** F1-measure outcomes with different techniques.

| Dataset | F1-Measure (%) | | | |
|---|---|---|---|---|
| | DCNN [17] | LSTM [18] | FCN [19] | CSO-SAN [Proposed] |
| 0 | 62 | 72 | 82 | 92 |
| 1 | 63 | 73 | 83 | 93 |
| 2 | 65 | 75 | 85 | 95 |
| 3 | 67 | 77 | 87 | 97 |
| 4 | 69 | 79 | 89 | 99 |

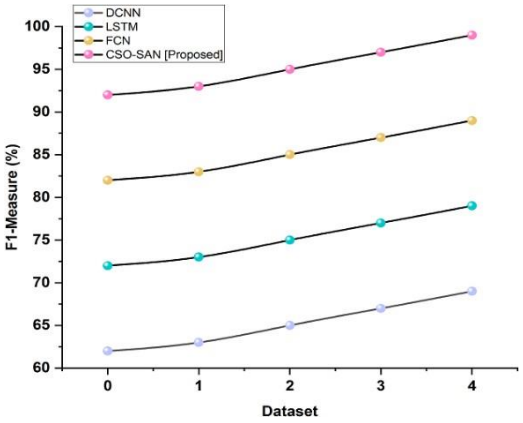


**Figure 5** Comparative Analysis of F1-measure.

### *3.5. Discussion*

The current flood warning systems usually track the spread of floods, such as the increase in the river and other bodies of water. However, there is a rising chance to create more complex models that might foretell infrastructure breakdowns during flood events as more sophisticated infrastructure data and methodology become available. The suggested hybrid DL model aims at precisely forecasting flood propagation. The case study in Mahanadi shows how the suggested CSO-SAN paradigm might provide early warning for cascading failure and sequential interruption. The suggested CSO-SAN model also applies to other infrastructure networks, such as the electricity grid and transportation systems, as well as other academic fields, like biology and information science. Its use is not only restricted to flood prediction.

The cascade failure of the system and the access to necessary facilities may therefore be anticipated using the records of component breakdowns over time. The proposed CSO-SAN model performs well in forecasting the flood cascade, although there are still certain areas where it might be improved. The CSO-SAN model is trained in this article using three flood events. However, a bigger training data set may further illuminate the benefit of DL techniques. Therefore, the training set may be increased to produce a more reliable and accurate flood forecast as more flood occurrences are recorded. Second, the construction sector also contributes significantly to the control of urban floods. Third, fresh categorization and period analysis methods are always being created as DL models advance quickly.

## 4. Conclusion

This paper provides a hybrid DL model called Cat Swarm Optimized Spatial Adversarial Network (CSO-SAN) and it's testing in a case study of flood prediction carried out in the Mahanadi river basin based on hydrological information obtained at four gauging stations. The CSO-SAN technique is a potential approach for determining flood frequency and predicting floods. The complicated nonlinear interactions between flood variables have been successfully captured by the CSO-SAN approach, making it suitable for forecasting and frequency study of floods. The predictive capability of the framework is

measured at 98.3% accuracy. Because the data set was unbalanced, we used precision, recall, and F-measure statistics to determine which parameters produced the most accurate results. According to the findings, the CSO-SAN model is superior to all of the other models used, which indicates that it may be used to acquire an accurate assessment of the frequency of floods and make predictions. Even though the CSO-SAN technique has shown encouraging results, more can be done. The CSO-SAN approach may be optimized by experimenting with other hyper parameters and structures or by incorporating additional machine learning methods.

**Ethical considerations**

Not applicable.

**Declaration of interest**

The authors declare no conflicts of interest.

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Analysis of educational data enabled by deep learning to increase student success

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**Abstract** A key component of improving educational quality is identifying pupils who are at a high risk of doing poorly academically as early as feasible. To accomplish this, most studies now in existence have used conventional Deep learning (DL) algorithms to forecast students' academic progress based on their behavior data, from which behavior elements are manually identified owing to the professional expertise and knowledge. Nevertheless, it has become increasingly difficult to recognize finely constructed handcrafted traits as a result of a rise in the types and quantities of behavioral data. The Enriched Plant Growth Optimized Artificial Neural Network (EPGO-ANN) technique enabled data analysis of educational data which is a viable tactic that may be used to improve student accomplishment in educational settings as we suggested in this research. The optimization predicts the academic success by autonomously extracting characteristics from student behavior data from several heterogeneous sources. This model's novelty employs recording the in-built time-series data for each kind of activity and uses EPGO-ANN to extract correlation features between various behaviors. The results of the experiments show that the suggested deep model approach outperforms several DL methods. The results of experiments show that the EPGO-ANN technique is superior to other DL methods.

**Keywords:** deep learning, student success, educational data, ANN, EPGO

## 1. Introduction

Automated feedback with Deep Learning (DL) capabilities may be an effective tool to help students revise their scientific arguments based on simulation-derived facts. Here are some actions to think about: Establish the learning goals. Before developing the automated feedback system, the learning objectives must be determined. To increase student achievement, Machine Learning (ML) may be used in the following ways: To design a tailored learning route that addresses each student's unique requirements, DL algorithms may be used to examine a student's learning patterns, strengths, and limitations. DL can help students reach their maximum potential by detecting areas of trouble and customizing their learning experience (Lee et al 2021). The chance that a student would drop out of a course or fail it may be predicted by DL algorithms by examining student data such as attendance, test results, and engagement. The data may be utilized to take early action and provide students who need specialized help (Gligorea et al 2022). Traditional tests sometimes use a one-size-fits-all methodology, which may be difficult for kids with varying learning preferences and aptitudes. DL algorithms may provide adaptive tests that adapt to a student's level of understanding and offer tailored feedback. Students need to be able to build scientific arguments using the data that the simulation produced. The system needs to evaluate the simulation's results and provide students feedback on their rationales for the claims they make (Abubakaria et al 2020).

Algorithms based on machine learning (ML) may be used to analyze the arguments and provide each learner with more tailored feedback. Analyze and enhance the feedback system: It is critical to test the feedback system with students to see how effectively it works once it has been developed. The study may gather information on student performance, and that information might then be utilized to enhance the feedback system. Include the curriculum's assessment system: The automated feedback system may also be a part of the curriculum. It is possible to do research through online assignments, in-person activities, and other methods (Manjushree et al 2021). An autonomous evaluation system with ML skills may help students improve scientific claims based on data from simulations. The study may assist students in strengthening their scientific reasoning abilities and achieving their learning objectives by identifying the learning objectives, selecting a suitable simulation, building the feedback system, testing and refining it, and introducing it into the curriculum. The DL method may be used to identify knowledge gaps and provide focused assistance. Writing analysis software (DL) may be used to evaluate student work and provide comments on grammar, sentence construction, and writing style. The strategy may assist students in developing their writing abilities, which are crucial for success in both college and the industry. Intelligent tutoring programs: DL algorithms can provide intelligent tutoring programs that give students individualized advice and assistance

(Sepulveda 2020). Student success can be impacted by a variety of factors related to learning. Students who engage in learning for teaching may have a deeper understanding of the material and be better able to apply what they have learned in real-world settings. This can lead to improved academic performance and success which are shown in Figure 1.

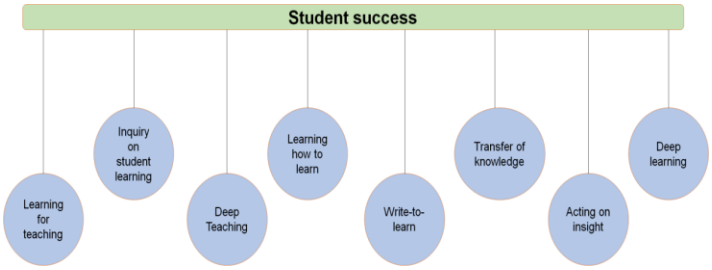


**Figure 1** Evaluation of student success.

The systems may support students in learning at their rate, provide targeted criticism, and adjust to their particular requirements. By offering students individualized learning experiences and tailored assistance, DL has the potential to revolutionize education. To help students succeed, instructors may pinpoint the areas where they struggle by analyzing vast volumes of data and using ML algorithms. The following measures must be taken in a methodical and data-driven manner to increase student performance via education data analysis: Definition of what student achievement looks like is the first step. Academic attainment, graduation rates, attendance, conduct, and any other relevant criteria may be used to determine success (Zabriskie et al 2019). Specify the performance measures that will be used to assess the academic success of the pupils. The research may contain indicators like GPA, exam scores, attendance rates, and other pertinent statistics. Select the analytic methods that will best aid in understanding the performance measures under review.

Techniques like regression analysis, clustering, or decision trees might be used in the research (Smith and Lovgren 2018). Make data visualizations that will make it simple to grasp the analysis of the data. Heatmaps, scatterplots, and bar charts might all be used in the research. Once the data has been examined, present the findings in a manner that is clear to all parties involved. The research might include producing dashboards that show important performance indicators or reports that compile the results. Apply the knowledge learned from the analysis to actions to improve the academic achievement of pupils. The research may include putting together tailored treatments for pupils who are having trouble or figuring out where more resources are required. An effective, simple-to-understand, and practical framework for interpreting pupils' academic achievement is required. The research may provide a framework to aid educators in making decisions that lead to higher student outcomes by following the stages (Yousafzai et al 2021).

Clear and quantifiable objectives are necessary to monitor progress and spot opportunities for growth. The next stage is to gather and evaluate pertinent data to learn more about the behavior and performance of the students. Data from evaluations, attendance logs, demographics, surveys, and other sources may be used in research. Finding trends, patterns, and correlations via data analysis may assist guide decision-making (Ahad et al 2018). After data analysis, it's critical to pinpoint areas where students are having difficulty and need more assistance. Research may be used to better the design of curricula, identify pupils who are at risk, or assess the quality of education. To increase student achievement, it is crucial to create and put into practice tailored interventions based on the learning from data analysis. Social-emotional learning initiatives, supplementary academic assistance, individualized learning plans, and other evidence-based treatments are all possible research topics. Regular progress monitoring is essential to ensuring that treatments are successful. Data on student performance may be tracked, interventions can be evaluated, and changes can be made as necessary all via research (Xiaoxiao and Dongdai 2020). By using the EPGO-ANN approach to increase student achievement, teachers can better understand student performance, spot areas for development, and provide kids with the individualized assistance they need to reach their full potential. Teachers may make sure interventions are successful and change their strategy as necessary to enhance student results by continuously monitoring and evaluating their work. Anupama and Elayidom (2022) decided which pupils needed to be informed and the research makes predictions about students' success in a course based on how well they have done in similar courses in the past. In the current cutthroat society, an institution needs to predict student performance, categorize people according to their skills, and work to improve their performance in upcoming exams. Analysis and prediction might benefit from the right patterns. Deshpande et al (2023) examined the academic achievement and failure serve as important stepping stones. The goal of the research is to identify early detection factors that may be used to predict children's tendency for academic achievement. Dien et al (2020) suggested the goal of the ML approaches used for identifying significant hidden patterns and investigating valuable data from educational contexts. The most crucial elements that may constitute the training dataset for supervised ML algorithms are the standard student characteristics (demographic, academic background, and behavioral aspects). Several supervised ML algorithms, including Decision Tree, Naive Bayes, Logistic Regression, and Sequential Minimal Optimization were compared in this research for their performance. Pallathadka et al (2021) evaluated the identification of academically underperforming students at an institution is vital, and Educational

Data Mining and DL aid these students by creating various recommendation systems to improve their performance. By identifying the priceless hidden patterns from their historical knowledge, the technologies guide the pupils toward their plans. Yakubu and Abubakar (2022) determined that Educational Data Mining (EDM) is becoming more significant since it aids in revealing relevant information from educational data sets that may be used for a variety of reasons, including forecasting students' academic success. Making and implementing various modifications may be beneficial to evaluate the students. ML has been engaged in the majority of recent studies to forecast kids' academic success using a variety of factors, including family income, student gender, absenteeism, and level, among others. Hashim et al (2020) evaluated in an attempt to determine whether or not students will be able to complete their degrees, the usefulness of utilizing the more precise CNN version of the DL algorithm to forecast students' accomplishments. Hussain et al (2019) developed predictive algorithms to predict how well students do in upcoming courses based on their academic scores. Akour et al (2020) analyzed the information gathered from two courses held on the Massive Open Online Courses (MOOCs) platform at National Tsing Hua University. According to their learning habits, the first model effectively assessed student performance. The solutions allow instructors to quickly identify underachievers and provide them with further support. Vijayalakshmi and Venkatachalapathy (2021) examined the forecast aids students in making informed course choices and self-designed study schedules. Furthermore, by using student performance prediction, lecturers and educational management may identify which students need to be watched over and helped to finish their programs with the greatest outcomes. By providing these resources, colleges may issue formal warnings less often and even expulse students who do poorly. Nabil et al (2021) suggested a strategy for forecasting student performance using several DL methods. A Vietnamese interdisciplinary university's student information system was used to acquire four million samples for the experiments, which were constructed on 16 datasets connected to a wide range of various disciplines. Results indicate that the suggested strategy, particularly when employing data modification, produces accurate prediction results. The conclusions apply to real-world situations. Rickles et al (2021) reported that raising students' test scores in the future depends on instructors' ability to effectively forecast students' subsequent learning impacts through techniques, based on their present and investigates the degree to which students are mastering future-related courses now. Researchers haven't given the use of DL approaches to forecast academic success and provide the best learning strategies much thought. Tao et al (2022) explored by using clustering algorithms to find comparable learning circumstances and predicting course grades based on student's prior experiences, the study can help students perform better in the classroom. Neha et al (2021) assessed the early detection of student performance in the classroom using DL and identified the students with an early warning; the algorithm performs a comparable category grouping.

The following is the paper's key contributions:

1. A whole chain based on students' multi-source daily behavior data, EPGO-ANN is suggested for the prediction of academic achievement. It can automatically extract characteristics without depending on specialized knowledge.
2. By combining ANN with an embedding layer, the time-series characteristics of each kind of behavior data are effectively recovered.
3. ANN is used to find the correlation characteristics between different sorts of behaviors.
4. The trials are performed using a sizable actual data set, and the results demonstrate that our suggested technique works better than the conventional DL methods.

The remainder of the document is structured as follows: In section 2, the research methodology and techniques used to collect and evaluate the data are described along with recommendations for future research based on the findings. Before presenting the research results concisely and systematically, analyzing and explaining them in light of the study aims or objectives, we go through the Discussion and results in section 3 first. Section 4 provides an overview of the Study's main elements, as well as its relevance and contributions, potential ramifications for practice or policy, and potential future study areas.

## 2. Materials and Methods

### *2.1. Data set*

The majority of undergraduate students attend colleges in Asia where they reside on campus, take many courses each semester, and are given grades or scores for each subject they pass. On campus, many kinds of behavior data are generated, including information on canteen intake and web page viewing.

### *2.2. Data elucidation*

The data set for this research was obtained from Beijing University over 145 days in the spring semester. Using extract, transform, and load (ETL) techniques, 9000 students' campus behaviors (Li et al 2022) were gathered from several databases. Data, time, place, and consumption quantity are the additional four characteristics of consumer behavior. Consumption behavior was among them, and it was further divided into breakfast, lunch, supper, and shopping activities. These behavioral

statistics accurately reflect the actions of students on campus in a variety of ways. All student IDs were permanently anonymized throughout the gathering procedure to safeguard students' privacy. The objective of this study is to forecast academic achievement using student behavior data from the university; hence, the student samples with the fewest behavioral records were eliminated. The exact conditions were that there should be a minimum of 20 behavior recordings every semester for each of the following: breakfast, lunch, dinner, and gateway login; and a minimum of 1000 behavior data for online browsing. The filtered dataset included 8228 student samples.

### *2.3. Data preprocessing*

The date and time must thus be preprocessed. By using the university calendar, the value of the date property was changed into an integer beginning at 1, where 1 denotes the date that corresponds to the first day of the calendar, and so on. The students may visit the same website several times in a short period; the duration of the experiment for web page browsing behavior was set at 4 hours. The behavior information may have been unnecessary if the value had been less. The other three categories of behaviors were set to 15 minutes. On gateway login behavior data, the same merge process is also carried out, and a new record's network traffic and online time are set to match the total of the merged records' values. The duplication-elimination process was done for both the behavior of entering libraries and browsing websites.

### *2.4. Intellectual performance evaluation*

The academic success of students is often evaluated by their cumulative GPAs. Predicting whether a student's performance will be excellent, good, or poor is how this research defines the classification job of academic performance prediction. The authors of pertinent research often artificially establish the thresholds since differing thresholds might provide different grading outcomes and restrict the comparison of model performance. The study established four thresholds—5%, 10%, 15%, and 20% to assess academic attainment to evaluate the model's performance as thoroughly as feasible. Table 1 displays the results of the grading and the number of students in each grade that fell within each range of GPA.

**Table 1** Evaluation of academic performance.

| **Academic** | **5%** | | **10%** | | **15%** | | **20%** | |
|---|---|---|---|---|---|---|---|---|
| | GPA | Student | GPA | Students | GPA | Students | GPA | Students |
| Good | (4,4) | 426 | (3.92,4) | 828 | (3.9,4 | 1249 | (3.8,4) | 1682 |
| Poor | [2.5, 4] | 7187 | [2.8, 3.92) | 6572 | [3.0, 3.9] | 5672 | [3.1, 3.8] | 4855 |
| Excellent | [0, 2.5] | 515 | [0, 2.8] | 828 | [0, 3.0] | 1372 | [0,3.1] | 1691 |

### *2.5. Deep learning techniques*

Studies using DL algorithms often characterize the challenge of forecasting academic accomplishment as a classification or regression job, to determine the degree or ranking of students' achievement. Data on students' behavior, as well as demographic data, were used to derive characteristics that confirm a good association between regular living habits and academic success. In addition, the method used two characteristics (orderliness and diligence) from student behavior data related to eating, taking a shower, going to the library, and getting water on campus and added attributes related to sleep patterns to orderliness and diligence. They developed a multitask academic performance prediction framework utilizing learning to rank algorithm based on the three attributes and used social influence theory to investigate the link between the student's academic success and comparable behaviors. From Internet connection records, the research derived the frequency and length of student visits to various websites. These studies use DL algorithms to forecast pupils' academic achievement. The DL classification task is performed by using EPGO-ANN technique.

#### *2.5.1. Enriched Plant Growth Optimized Artificial Neural Network (EPGO-ANN)*

Enhanced plant growth optimized artificial neural network (EPGO-ANN)-enabled data analysis of educational data is a potential strategy that may be utilized to increase student achievement in educational environments. The goal of this strategy is to improve student learning outcomes by analyzing educational data, seeing patterns and trends, and optimizing instructional tactics. The following are some strategies for using the study of educational data made possible by EPGO-ANN to improve student achievement:

- *Personalized Learning:* By analyzing educational data, EPGO-ANN can determine the best learning environments for certain students. To suit the unique requirements of each student, this may be utilized to tailor learning methodologies and lesson programs.
- *Predictive Analytics:* Using prior educational data analysis, EPGO-ANN can forecast future performance. This may assist educators in identifying pupils who are at risk and helping them succeed via focused interventions.

- *Curriculum Development:* The most efficient teaching methods and lesson plans for certain subjects may be found by analyzing educational data using EPGO-ANN. This may help with curriculum planning and guarantee that the best possible learning opportunities are given to the kids.
- *Student Engagement:* The most efficient teaching methods and lesson plans for certain subjects may be found by analyzing educational data using EPGO-ANN.

### *2.5.2. Enriched Plant Growth Optimization*

Specify performance indicators that will be used to gauge how well the optimization procedure has worked. These might consist of parameters like plant height, yield, or quality which includes:

- *Identify Optimal Conditions:* Use data analysis tools and techniques, such as machine learning algorithms, to identify the optimal combination of environmental conditions for plant growth.
- *Monitor Performance:* Follow the development of the plant and the surrounding environment over time to make sure the optimization process is yielding the expected outcomes. This can include gathering more information and, if necessary, modifying the optimization strategy.
- *Evaluate Results***:** Utilize the efficiency measures outlined in step 2 to assess the outcomes of the optimization process. This will assist in determining if the procedure was effective and pointing out any areas that may need more attention.
- *Continuously Improve:* By gathering more data, improving analytical tools and models, and discovering fresh areas for improvement which may gradually enhance the optimization process. Enriched plant growth optimization is a useful strategy for enhancing plant growth and raising agricultural output overall. Farmers and other stakeholders may optimize plant development and boost agricultural yields by determining the ideal set of environmental factors and making adjustments appropriately.

### *2.5.3. Artificial Neural Network*

Artificial neural networks (ANNs) with numerous layers are used in the deep learning discipline of machine learning to model complicated connections in data. A machine learning model called an ANN is created to mimic the form and operation of biological neural networks. Neurons, which are layers of linked nodes in an ANN, process, and transfer information. Each neuron takes data, processes it, and then sends the results to the layer of neurons below it. An artificial neural network (ANN) has layers of neurons, with the input layer accepting input data and the output layer creating output data. The input data are transformed into the output data via intermediary processing carried out by the hidden layers.

## **3. Results**

In this part, we go through the training and performance evaluation of the EPGO-ANN. Three significant issues, including the class imbalance issue, overfitting, and assessing the EPGO-ANN approach, are resolved.

### *3.1. The generalized function of loss to address the issue of class imbalance*

The accomplishment prediction task has a class imbalance issue, as can be demonstrated by looking at the dataset in Table 1. The three main kinds of solutions to this issue are weighted loss function, under-sampling technology, and over-sampling technology. To balance the three groups of students, the second kind of strategy involves creating fresh samples of individuals with both low and good test results. The traditional over-sampling EPGO-ANN technique is computationally inefficient when synthesizing high-dimensional student samples indicated by different behaviors. The third kind just gives students' low and high test scores greater weight when calculating the loss function, so enhancing the influence of these samples on the loss function. Neither samples are created nor removed. Since it requires fewer processing resources than over-sampling methods, we decided to employ the weighted loss function in this study to address the class imbalance problem. We employed the weighted loss function to resolve the class imbalance issue since it uses less processing power than over-sampling techniques, which is why we chose to do so in this research. In Equations 1 and 2, the weighted cross entropy loss function is shown, where $u_j$ shows the importance of class i, M is the quantity of all student samples, $M_j$ is the proportion of class-specific student samples j, N is The number of lessons, together with the actual score level, $z^l_j$ student samples belonging to class i, and $o^l_j$ is the predicted score level probability.

$$u_j = \frac{M}{N * M_j} \quad (1)$$

$$loss = \frac{1}{M} \sum_{l=1}^{M} \sum_{j=1}^{N} u_j z^l_j \log(o^l_j). \quad (2)$$

### *3.2. Evaluation metrics*

The three-way classification accomplishment prediction task was established by equations 3 and 4, $O_j$ and $Q_j$ represent the subclasses of bad, good, and outstanding results, accordingly. Equation 5 represents $E_\beta^j$ which is a trade-off metric between $O_j$ and $Q_j$. $O$ indicates the class's accuracy rate. j, Q indicates the recall rate of class i captured by a model which is represented in equation 6 and 7, and the proportional weights of accuracy and recall in $E_\beta$ metric is adjusted by setting β value which was shown in equation 8.

$$O_j = \frac{SO_j}{SO_j + EO_j} \quad (3)$$

$$Q_j = \frac{SO_j}{SO_j + EM_j} \quad (4)$$

$$E_\beta^j = \frac{(1+\beta^2)*O_j*Q_j}{(\beta^2 * O_j) + Q_j} \quad (5)$$

$$O = \frac{1}{3}\sum_{j=1}^{3} O_j \quad (6)$$

$$Q = \frac{1}{3}\sum_{j=1}^{3} Q_j \quad (7)$$

$$E_\beta = \frac{(1+\beta^2)*O*Q}{(\beta^2 * O) + Q} \quad (8)$$

### *3.3. Evaluation of the performance of the EPGO-ANN model using various behavioral information*

The four assessment metrics of prediction performance based on EPGO-ANN and multi-source behavior which are all greater than those of any kind of single behavior data, notably in the macro recall meter according to the observation of Figures 2, 3, 4, and 5. Although there are considerable variances in macro F1-score, precision, accuracy, and recall, there are very few differences in prediction results based on a single behavior. Overall, gateway login and shopping activity come in second and third, with lunch coming in last. Prediction performance based on breakfast and dinner behavior is best overall. The worst actions include entering libraries and surfing websites.

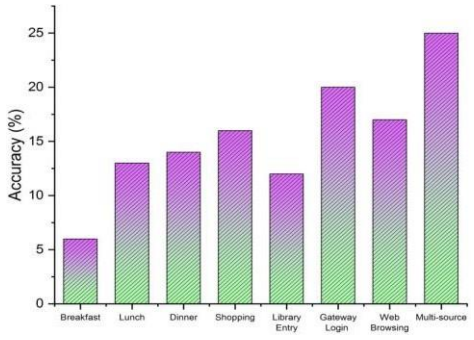


**Figure 2** Comparison of accuracy based on different behavior data.

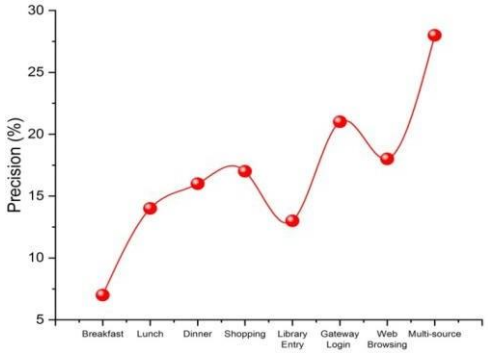


**Figure 3** Comparison of precision based on different behavior data.

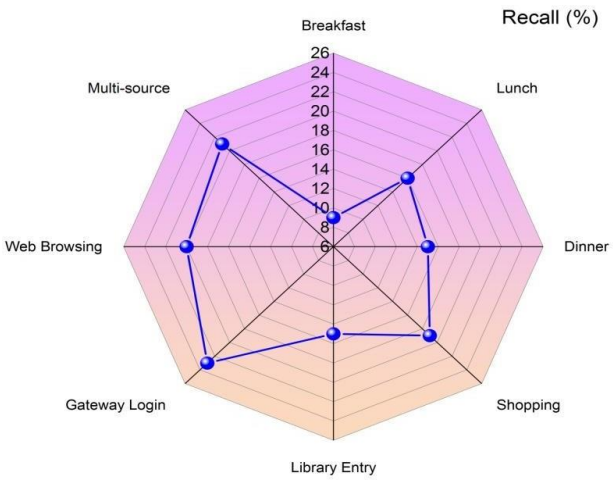


**Figure 4** Comparison of recall based on different behavior data.

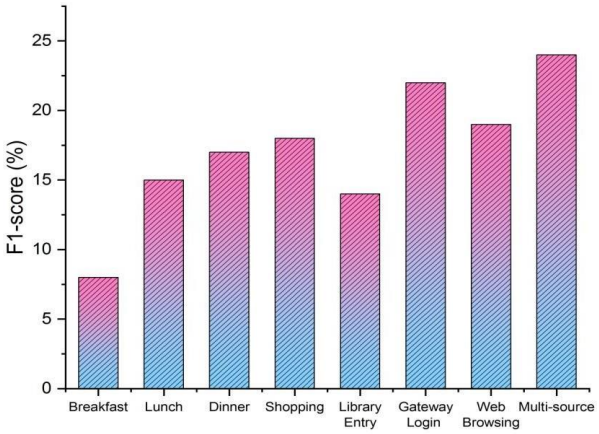


**Figure 5** Comparison of F1-score based on different behavior data.

### *3.3.1. Accuracy*

In the context of machine learning models like the EPGO-ANN, accuracy refers to the percentage of examples that are properly identified or predicted out of all occurrences. To put it another way, accuracy assesses how effectively the model can recognize or forecast the desired output based on the input data. The accuracy would be determined by dividing the total number of cases in the test set by the number of instances that were properly categorized. A high accuracy shows that the model can correctly predict the outcome variable from the input variables, while a low accuracy indicates that the model may need to be improved or that other factors may need to be included to increase its ability to predict the future.

Accuracy takes into consideration all of the model's predictions since it assesses how effectively the model can distinguish between positive and negative scenarios. When equation 9's positive and negative instances are not significantly out of balance, this measure is helpful. Accuracy may not provide a comprehensive view of the model's performance in circumstances when the dataset is unbalanced; instead, supplementary measures like precision and recall may be more useful.

$$\text{Accuracy} = \frac{\text{TP+TN}}{\text{TP+TN+FP+FN}} \qquad (9)$$

Table 2 displays the proposed procedure's precision and accuracy. A percentage of the total is often used to represent precision levels. The suggested factor, multi-source has a 28% precision rate compared to Breakfast, Lunch, Dinner, Shopping, Library entry, gateway login, and web browsing, multi-source which has 7%, 14%, 16%, 17%, 13%, 21%, 18%. The suggested factor, multi-source has a 25% accuracy rate compared to Breakfast, Lunch, Dinner, Shopping, Library entry, gateway login, and web browsing, multi-source which has 6%, 13%, 14%, 16%, 12%, 20%, 17%.

**Table 2** Numerical outcomes of Precision and accuracy based on different behavior data.

| Factors | Precision (%) | Accuracy (%) |
|---|---|---|
| Breakfast | 7 | 6 |
| Lunch | 14 | 13 |
| Dinner | 16 | 14 |
| Shopping | 17 | 16 |
| Library Entry | 13 | 12 |
| Gateway Login | 21 | 20 |
| Web Browsing | 18 | 17 |
| Multi-source | 28 | 25 |

### *3.3.2. Precision*

Precision is a statistic that assesses the percentage of accurate positive predictions among all positive predictions generated by a machine learning model, such as the EPGO-ANN. In other words, precision describes the accuracy or precision of the model's optimistic forecasts. When false positives (identifying someone as having a specific behavior when they don't) are expensive or have substantial repercussions, precision is a crucial statistic. Equation 10 displays the high accuracy score, which demonstrates that the model has a low rate of false positives and makes accurate positive predictions. High accuracy may often be paired with poor recall, which indicates that a significant portion of real positives may be missed by the model. Therefore, to assess the total performance of the model, precision should be used in combination with other metrics like recall and accuracy.

$$\text{precision} = \frac{\text{TP}}{\text{TP+FP}} \qquad (10)$$

### *3.3.3. Recall*

A recall is a statistic that assesses the percentage of accurate positive predictions among all real positive instances in the dataset, and it is used in machine learning models like the EPGO-ANN. Recall, then, measures the model's accuracy in properly identifying positive instances. When false negatives identify someone as not exhibiting a certain behavior when research is expensive or has major repercussions, recall becomes a crucial measurement. Equation 11 displays the high recall score, which demonstrates that the model has a low incidence of false negatives and can properly identify a large percentage of real positive events. However, poor accuracy may coexist with high recall, which increases the likelihood of false positives in the model. Recall should, therefore, be used in combination with other measures, such as precision and accuracy, to assess the model's overall performance.

$$\text{Recall} = \frac{\text{FN}}{\text{FN+TP}} \qquad (11)$$

Table 3 displays the proposed procedure's recall and F1-Score. The suggested factor, multi-source has a 21% recall rate compared to Breakfast, Lunch, Dinner, Shopping, Library entry, gateway login, and web browsing which has 9%, 16%, 15%, 19%, 14%, 23%, 20%, and suggested factor, multi-source has a 24% F1-score rate compared to Breakfast, Lunch, Dinner, Shopping, Library entry, gateway login, web browsing, multi-source which has 8%, 15%, 17%, 18%, 13%, 22%, 19%.

**Table 3** Numerical outcomes of Recall and F1-score and accuracy based on different behavior data.

| Factors | Recall (%) | F1-score (%) |
|---|---|---|
| Breakfast | 9 | 8 |
| Lunch | 16 | 15 |
| Dinner | 15 | 17 |
| Shopping | 19 | 18 |
| Library Entry | 14 | 13 |
| Gateway Login | 23 | 22 |
| Web Browsing | 20 | 19 |
| Multi-source | 21 | 24 |

### *3.3.4. F1-score*

F1-score is a statistic that combines accuracy and recall to provide an overall assessment of the performance of machine learning models like the EPGO-ANN. The harmonic mean of accuracy and recall, which gives both measures equal weight, is used to generate the F1 score. When the dataset is unbalanced—that is, when there are more instances of one class (such as non-smokers) than another (such as smokers), the F1-score is a helpful indicator. Equation 12 illustrates how uneven accuracy and recall may be distorted, while the F1-score offers a fair evaluation of the model's performance. A high

F1 score means that the model is doing well in terms of accuracy and recall, while a low F1 score indicates that the model may need to be improved or that more variables may need to be added to the model.

$$\mathrm{F1-score} = \frac{(\mathrm{precision})\times(\mathrm{recall})\times 2}{\mathrm{precision}+\mathrm{recall}} \qquad (12)$$

## 4. Conclusions

A potential strategy that may be utilized to increase student achievement in educational settings is the study of educational data made possible by deep learning. To improve learning outcomes and student achievement, educators may take well-informed choices by using machine learning algorithms to evaluate educational data and spot patterns and trends. Data from the educational sector lends itself especially well to deep learning algorithms, such as EPGO-ANN. EPGO-ANN may be used in education for a variety of purposes, such as individualized learning, predictive analytics, curriculum building, and student engagement. It can model complicated interactions between input and output data. We draw the conclusion that educators can learn more about the precise elements that lead to student achievement via the analysis of educational data and may create interventions that are specifically tailored to help students who may be having trouble. Informing the creation of curriculum that are tailored for student learning, deep learning algorithms may also be used to determine the best teaching methods and subject matter. The study of educational data made possible by deep learning has the potential to transform education and enhance student results in a variety of contexts. Educators may make data-driven choices that result in improved learning outcomes and more student achievement by using the power of machine learning algorithms. An EPGO-ANN model for forecasting students' academic achievement using data on their on-campus daily activities is suggested in this work. Our approach tackles the difficulties of manually collecting characteristics from data on several sources of varied behavior.

### Ethical considerations

Not applicable.

### Declaration of interest

The authors declare no conflicts of interest.

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Predicting future housing prices: a machine learning approach

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**Abstract** In our ecosystem, the real estate sector is the least transparent. Daily changes in housing prices as well as sometimes exaggerated prices rather than valuations are a part of life in the housing market. Our research project's major focus is on predicting future housing prices using actual machine learning. Here, we want to concentrate our judgments on each fundamental factor that goes into calculating the price. Machine learning has played a significant role in picture identification, spam restructuring, normal speech command, product suggestion, and medical diagnosis in recent years. The current machine learning method aids us in improving security warnings, maintaining public safety, and improving medicinal advancements. Machine learning technology also improves customer service and makes automobiles safer. The current research discusses the prediction of future housing prices provided by a machine learning system. The data was preprocessed after it was collected. In this procedure, we employ the Forest Neural Gradient Boosting Algorithm (FNGBA). We evaluate and compare several prediction techniques for the selection of prediction methods. Our findings demonstrate the necessity for a successful approach to the problem and the capability of our method to provide predictions that can be compared to existing models of housing price prediction. When compared to employing independent methods, the findings showed that this technique delivers the least mistake and the maximum accuracy.

**Keywords:** housing price, machine learning, FNGBA

## 1. Introduction

One of the most important decisions a person makes in their life is purchasing a house. Numerous factors, such as a house's location, attributes, and supply and demand in the real estate market, may influence its price. Another crucial component of the national economy is the housing sector (Yap and Ng 2018). As a result, anticipating house prices benefits not only purchasers but also real estate brokers and economists. Housing market forecasting studies look at home prices, growth trends, and their links with various factors (Wu and Brynjolfsson 2015). Over the last several years, the development of machine learning methods and the explosion of data or big data accessible have opened the way for real estate research (Zhou et al 2019). There is a wide range of research that uses statistical learning approaches to analyze the housing market. Machine learning is heavily used in this approach. The machine learning prediction process goes through several phases. Before analysis, data are first collected and processed (Grieco et al 2016).

The data may need to be cleaned up, formatted properly, and given the proper features. The machine-learning model is subsequently trained using the prepared data (Hussain et al 2019). To acquire the perfect combination of features and algorithms for producing accurate predictions, the model is updated. Giving reliable datasets is a need of machine learning, and predictions made thereafter are dependent on them. A machine learning model may be trained to predict housing prices using historical data on sales of homes and information on the factors that influence house prices (Hu et al 2019). A model that can predict housing prices based on input characteristics may be trained using this data. For predicting house prices, a variety of machine learning techniques may be utilized, such as decision trees, random forests, and linear regression (Rodriguez-Galiano et al 2015).

The purpose of the essay was to assist both buyers and sellers in accurately estimating a home's selling price as well as to assist readers in determining when to start building a home (Madhuri et al 2019). (Wang et al 2019) presented a deep learning-based model for predicting future home prices, and we show how it can be deployed using the TensorFlow library. The model is trained using the Adam optimizer, and the Relu function is employed as the activation function. (Adetunji et al 2022) investigated the use of the Random Forest machine learning approach for predicting home prices. 506 items and 14 characteristics from the Boston housing dataset from the UCI Machine Learning Repository were used to assess the effectiveness of the suggested prediction model.

(Lu et al 2017) suggested a hybrid Lasso and Gradient boosting regression model to forecast the price of each home. Recently, the suggested strategy was implemented as the primary kernel for the Kaggle Challenge "House Prices: Advanced Regression Techniques." (Yu et al 2018) examined the secondary market for real estate in Beijing from three perspectives: a review and analysis of the market, a prediction of future housing prices, and a comparison of the results. In the end, the best model program was developed, which has significant implications for assessing and forecasting home prices. (Bency et al 2017) offered a methodology for employing Convolutional Neural Networks (CNNs) to model geospatial data (in this case, home price data) to automatically learn the spatial correlations between variables. (Wang et al 2019) compared the properties of a Random Forest (RF)-based home price predictor with those of a traditional hedonic pricing model to better understand its strengths and weaknesses. They analyzed condo sales in Gangnam, one of South Korea's most affluent neighborhoods, from 2006 through 2017. (Lisi et al 2019) provided commentary on the application of hedonic pricing models to real estate valuation. Some housing markets may benefit greatly from the concept. The Forest Neural Gradient Boosting approach (FNGBM), which provides a more accurate result than any other approach, is introduced in this research for predicting future housing prices.

## 2. Materials and Methods

From the major real estate agency in the Christchurch region, Harcourt, we randomly choose 200 house details to analyze. In May 2003, we obtained the dataset from Harcourt's website. Due to the concentration of businesses, restaurants, and stores in the downtown area, the percentage of homes is quite low. Only 15 house records are gathered from the central city, 25 from North Christchurch, and 40 from the other four designated areas. In all, 200 separate observations are used here.

### *2.1. Z-score normalization*

Z-score normalization uses the data's mean and standard deviation as its starting points. In cases when the lowest and maximum values of the data are unknown, this technique is of great use. This is the formula that is used:

$Y_{new} = \frac{y-\mu}{\sigma} = \frac{y-Mean(Y)}{stdDev(Y)}$

$Y_{new}$=The adjusted value obtained after scaling the data

Y = outdated value

μ = Statistics mean

σ = Estimated Standard Deviation

### *2.2. Forest Neural Gradient Boosting Algorithm*

The Gradient Boosting algorithm iteratively combines weak learners who are just slightly superior to random—into effective learners. A regression approach similar to boosting is called gradient boosting. The objective of finding an approximation is done using gradient boosting. E (v), of the operator $E^*(v)$, which translates examples to their final values y, by examples to their final values of a specified loss function, $L(z, E(v))$, provided a training dataset $C = \{v_j, z_j\}_1^M$, Gradient boosting produces a weighted average of variables that additively approaches the value of $E^*(v)$.

$$E_m(v) = E_{m-1}(v) + \rho_n g_n(n) \quad (1)$$

Where $E_m$is the n[th] variable weight, $\rho_n$ (v). Those are the ensemble's models, such as decision trees. The closest estimate is built up gradually. At first, an approximate constant representation of $E^*(v)$ is found as

$$E_0(v) = arg \min_{\alpha} \sum_{j=1}^{M} K(z_j, \alpha). \quad (2)$$

Future models are anticipated to reduce

$$(\rho_n g_n(n)) = arg \min_{\alpha} \sum_{j=1}^{M} K(z_j, E_{n-1}(v_j) + \rho g(v_j)) \quad (3)$$

In contrast to explicitly addressing the optimization issue, every $\rho_n$might seem to rapacious move in the gradient reduction efficiency for $E^*$. Every simulation ($\rho_n$) is then qualified on a different dataset $C = \{v_j, z_{nj}\}_{j=1}^{M}$,, with pseudo-residuals ($q_{nj}$) determined by

$$q_{nj} = \left[\frac{\partial K(z_j, E(v))}{\partial E(v)}\right]_{E(v)=E_{n-1}(v)} \quad (4)$$

After that, we solve an optimization issue involving a line search to get the value of n. Over-fitting may occur in this approach

if the iterative procedure is not adequately regularized. If the model properly hm fts the pseudo-residuals, the procedure will stop after just one iteration if the loss function is a quadratic loss, for example. To regulate the cumulative effect of gradient boosting, several regularization hyper-parameters are taken into account. Regularizing gradient boosting is as simple as applying shrinkage to each gradient decent step $\rho_n(v) = p_{n-1}(v) + x\,\rho_n g_n(v)$ with x= (0, 1.0). Typically, is given a value of 0.1. Regularization may be improved by putting constraints on the learned models' complexity. For decision trees, we may restrict the lowest value of occurrences needed to split a node or the depth of the tree. While random forest's default settings for those hyper-parameters don't restrict the expressive capacity of the trees, the default values in gradient boosting do (for example the depth is often restricted to 3 5). Last but not least, random subsampling without replacement belongs to a class of hyper-parameters that is incorporated in several gradient-boosting variants and may further enhance the generalization of the ensemble. Gradient boosting's last traits to be put to the test are:

- Shrinkage, also known as learning rate.
- The tree's greatest depth: the same significance as that of the trees produced by random forests.
- The fraction of the whole sample is taken as a subsample. This is often done without replacement.
- Similar to a random forest, the maximum amount of features are used to determine the optimal split (max_features).
- A minimal number of samples are needed to divide an inner node, like in a random forest (min_samples_ split).

In forest regression, the bagging of trees technique is used. Making the different trees seem less like they belong together is the goal. Then, to reduce their variation, we average the trees. Several decision trees might be built using this strategy.
The random forest method of training uses bootstrap aggregation (sometimes called bagging) to train tree-based models. It selects a random subset of the training data $V = v1, \dots, vm$ and repeatedly fits trees to this subset $Z = z1, \dots, zm$ until convergence is achieved, a process called "bagging." $a = 1, \dots, A$:

1. Using V and Z as training data randomly choose n training samples ($V_a, Z_a$).
2. Put V and Z through a $ea\ on V_a, Z_a$ classification/regression tree's training process.

After training, you may make predictions about future samples b' by averaging the outputs of many regression trees that have been fed the same data:

$$\hat{e} = \frac{1}{A}\sum_{a=1}^{A} ea\,(v') \qquad (5)$$

The standard deviation of the predictions generated by each regression tree on a' provides an additional measure of the prediction's uncertainty.

$$\sigma = \frac{\sqrt{\sum_{a=1}^{A}(ea(v')-\hat{e})^2}}{A-1} \qquad (6)$$

In addition, the output from each of these methods is used as training data for the neural network. To provide a precise outcome, we use a neural network to boost regression. Neural networks are effective because they compare and compute all of the predictions to provide the most accurate outcome. Figure 1 illustrate how the system operates. The consumer, the database, and the website all constitute separate but equal objects. The algorithmic computational mechanisms are also included. The user interface prompts the consumer to input the desired location, desired area, and other factors related to the home purchase. The user enters their desired price range and desired location, and the system shows houses that fall inside that range.

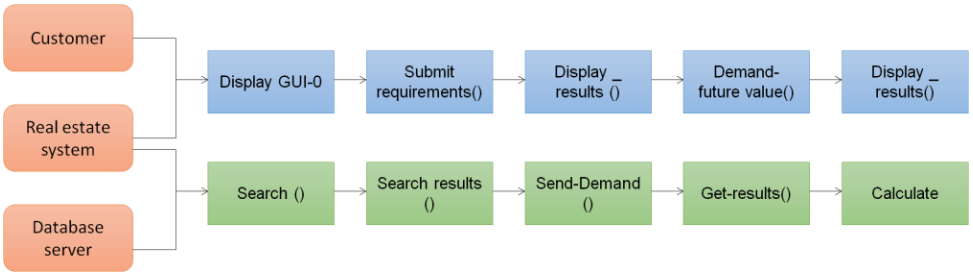


**Figure 1** Diagram of the sequence.

### 3. Result

In this paper, we use the FNGBA Technique to predict the future price of housing. We have examined several of the previously established approaches, such as CNN, SVR, and LSTM, and contrasted them with our technique FNGBA.R2, RMSE, accuracy, and prediction rate are the metrics that are being used.

### *3.1. Accuracy*

Accuracy is a statistical metric that is used to reflect the degree to which the anticipated value and the actual value are similar to one another. The higher denotes a better performance. Figure 2 and Table 1 show comparisons between the recommended strategy and more conventional methods. The FNGBA technique that was suggested had a higher degree of accuracy.

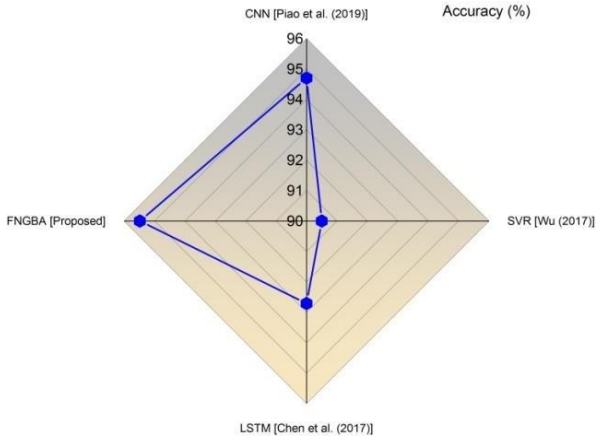


**Figure 2** Accuracy comparisons between the suggested and current approaches.

**Table 1** Comparison of Accuracy.

| Methods | Accuracy (%) |
|---|---|
| CNN [Piao et al (2019)] | 94.7 |
| SVR [Wu (2017)] | 90.5 |
| LSTM [Chen et al (2017)] | 92.71 |
| FNGBA [Proposed] | 95.48 |

$$\text{Accuracy} = \frac{[observed_t - predicted_t]}{observed_t} \times 100\% \quad (7)$$

### *3.2. The $R^2$*

The $R^2$ or coefficient of determination is a statistical metric used to assess the extent that a model fits the data. It is a statistical measure used to assess the reliability of the regression line. Figure 3 and Table 2 show comparisons between the recommended techniques with more conventional methods, respectively. The FNGBA strategy that was suggested had a higher degree of R2 compared to the earlier research.

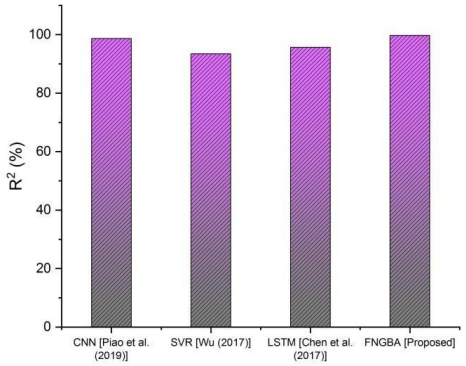


**Figure 3** The $R^2$comparisons between the suggested and current approaches.

**Table 2** Comparison of $R^2$.

| Methods | R2 (%) |
|---|---|
| CNN [Piao et al (2019)] | 98.68 |
| SVR [Wu (2017)] | 93.45 |
| LSTM [Chen et al (2017)] | 95.72 |
| FNGBA [Proposed] | 99.72 |

$$R^2 = 1 - \frac{\sum_{i=1}^{n} (P_i - P_i)^2}{\sum_{i=1}^{n} (P_i - \overline{P})^2} \quad (8)$$

*3.3. RMSE*

An estimator's RMSE for a population parameter is its MSE multiplied by its square root. The MSE is calculated by taking the square root of the anticipated value of the discrepancy between the estimate and the parameter. In Figure 4 and Table 3, respectively, comparisons between the recommended technique and more conventional methods are shown. In comparison to the earlier research, the FNGBA technique has a lowered error rate.

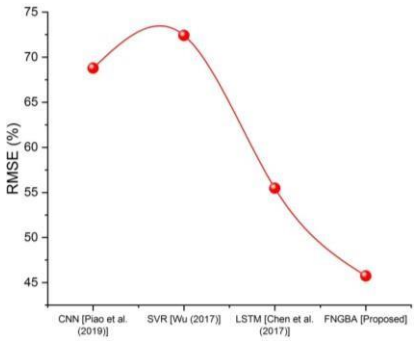


**Figure 4** Comparison of RMSE of the existing and proposed methodologies.

**Table 3** Comparison of RMSE.

| Methods | RMSE (%) |
|---|---|
| CNN [Piao et al (2019)] | 68.78 |
| SVR [Wu (2017)] | 72.42 |
| LSTM [Chen et al (2017)] | 55.48 |
| FNGBA [Proposed] | 45.75 |

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n} (P_i - \hat{P}_i)^2} \quad (9)$$

*3.4. Precision*

Precision is a statistic used in binary classification issues to evaluate the percentage of genuine among the most optimistic predictions generated by the model. In other words, precision measures the model's accuracy in making positive predictions. Comparisons of the suggested method with traditional approaches are presented in Figure 5 and Table 4, respectively. the FNGBA technique that was suggested had a higher precision rate.

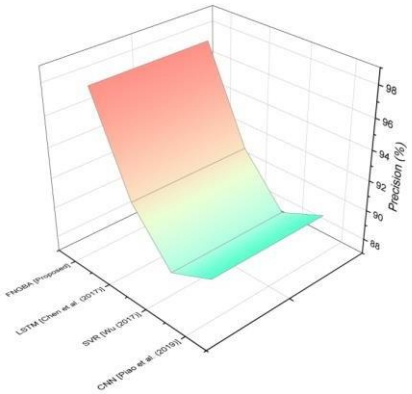


**Figure 5** Comparison of Precision of the existing and proposed methodologies.

**Table 4** Comparison of Precision.

| Methods | Precision (%) |
|---|---|
| CNN [Piao et al (2019)] | 89.78 |
| SVR [Wu (2017)] | 88.54 |
| LSTM [Chen et al (2017)] | 91.71 |
| FNGBA [Proposed] | 97.74 |

$$Precision = \frac{True\ Positives}{True\ Positives + False\ positives}$$

## 4. Discussion

The process of predicting house prices is intricate and diverse, requiring a thorough grasp of the housing market and the variables that influence it. It is possible to create exact projections about future housing prices and to decide on buying, sale, or investment in real estate by using the forest neural gradient boosting algorithm.

## 5. Conclusions

The goal of this approach is to create an exact prediction of future housing prices. Forest regression is used effectively by the system. The addition of neural networks has significantly enhanced the algorithm's efficiency. Consumers will be impressed since the method eliminates the possibility of purchasing the incorrect property and produces reliable results. The system's essential functioning may be maintained while new features for the customer's benefit are introduced. Larger cities may be added to the database in a future update, allowing our customers to see additional houses, get more precise information, and make an informed choice. The system's precision may be enhanced. If the system is made larger and has more processing capacity, it will be possible to include many more citations. In addition, using Augmented Reality, we may combine several UI/UX approaches for a more dynamic display of the outcomes. In addition, a learning system may be developed that takes into account user input and past activity to provide personalized outcomes.

## Ethical considerations

Not applicable.

## Declaration of interest

The authors declare no conflicts of interest.

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Improving wind energy efficiency with machine learning-driven wind speed forecasting

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**Abstract**The broad use of wind power plants is a result of the rising need for renewable energy. However, it is difficult to effectively harness wind energy due to the inconsistent and erratic behaviour of the wind. Improved wind energy system effectiveness depends on reliable wind speed forecasting. We suggest a unique marine predator-optimized convolutional deep belief network (MP-CDBN) in this study for predicting wind speed. The MPO technique is employed for optimizing the MP-CDBN framework once it has been trained using prior wind data. An evaluation and comparison of the suggested model with other wind speed prediction techniques are conducted. The suggested MP-CDBN model's precise wind speed predictions have the potential to increase the effectiveness of wind energy installations. The suggested approach can aid in lowering carbon dioxide emissions and encouraging the production of renewable energy by increasing the effectiveness of wind power plants.

**Keywords:** WPP, energy efficiency, erratic behavior, prediction, MP-CDBN

## 1. Introduction

Wind energy has one of the alternative power resources with the fastest pace of increase, which is becoming more and more popular worldwide. The marketplace for wind energy has grown as a result of worries over warming temperatures and a desire to reduce emissions of greenhouse gases. Wind energy generation, despite its benefits, is prone to variations and uncertainties, which make it difficult to incorporate into the electrical system (Han et al 2017). A key technique for increasing wind energy efficiency and making it possible for it to be integrated into the grid is wind energy forecasting. In order to maximize the uses of alternative power sources, increase system dependability, and lower costs, accurate wind energy forecasting can assist grid operators in anticipating changes in energy supply and demand (Pearre et al 2018). Increasing the total effectiveness of wind energy systems is the driving force behind wind energy forecasting. The underutilization of wind energy systems due to inaccurate estimates can result in wasted energy and higher operational expenses. A system that is unstable may experience power outages and other disturbances if wind energy production is overestimated (Liu et al 2020). Wind energy forecasting aims to give grid operators, energy dealers, and other stakeholders accurate predictions of wind energy output (Zhou et al 2019). The use of sophisticated modeling methods, such as machine learning algorithms, is necessary for accurate forecasting in order to take into consideration weather patterns, wind speeds, and other variables that impact the generation of wind energy. Furthermore, the development of future wind energy initiatives depends on accurate wind energy forecasts (Sun et al 2017).

Greater precision in wind energy output forecasting can aid in the planning and optimization of wind energy projects, leading to more efficient and economical energy production. Alkesaiberi et al (2022) intended to create effective models that use data to precisely anticipate the generation of wind energy. Importantly, the next primary components include an overview of the work's key accomplishments. In order to anticipate single-variate wind power data collected over time, they look first into how well-upgraded machine learning systems function. Ibrahim et al (2020) show the growing need for the quick growth of machine learning approaches used for effectively addressing the technological problems of the smart electricity system from a variety of angles. Additional research is necessary on a number of topics, including compact machine learning-driven remedies, large-scale complicated multi-energy structures, smart decision-making using powerful data processing and analysis systems, and so on. Shams et al (2021) presented an alkaline water electrolyzer (AWE) and battery energy storage system (BESS) with optimum size and management guided by deep learning. Deep learning forecasting techniques were used to completely study a collection of real renewable energy restriction data from the California ISO in order to estimate the error in forecasting and its probability distribution function (PDF).

Yang et al (2020) created sophisticated machine-learning techniques to produce precise weather projections for specific development locations utilizing easily accessible meteorological station information. To determine the

spatiotemporal connections among the conditions at neighboring weather stations and the particular construction location, the methods of support vector regression and artificial neural networks have been used. The effectiveness of two widely used latent factor analysis approaches, "principal component regression" (PCR) and "partial least squares regression" (PLSR), for forecasting wind power was examined (Bouyeddou et al 2021). The accuracy of the predicted values produced by the researched strategies is demonstrated using genuine measurements taken each ten minutes from a real turbine. (Wang et al 2019) offered a thorough and in-depth analysis of deep learning-based methods of forecasting energy from renewable sources to investigate their efficacy, productivity, and possibility of implementation. They classify the present deep learning-based deterministic and probabilistic forecasting techniques into four divisions: deep belief networks stack auto-encoders, deep recurrent neural networks, and others. Neshat et al (2021) applied a unique hybrid deep learning-based evolutionary technique to enhance the wind speed correctness of forecasts. This hybrid model includes a successful hierarchy evolution deconstruction method, a bidirectional long short-term memory neural network, and an enhanced generalized distributional optimization approach for hyper-parameter tuning. In order to enhance rotor wakes forecasts, an innovative approach using machine learning and CFD simulation was suggested (Ti et al 2020). This structure will provide fresh wake speed and mathematical turbulence models with high accuracy as well as high effectiveness. The convolutional Neural Network (CNN) model is employed with transfer learning and an ensemble learning classifier to enhance the classification accuracy of the suggested deep learning model. While the suggested approach's capacity for extracting abstraction characteristics is improved via the application of transferred learning, its reliability of identifying blade flaws is increased through the use of group-learning classifiers constructed from random forest data (Yang et al 2021).

The development of precise and trustworthy algorithms that can estimate the potential future development of the production of wind power is an important topic for wind energy prediction. This involves tackling issues including the erratic and sporadic nature of wind assets, how conditions affect wind speed, and the necessity of maximizing power production and connection to the grid. Improving techniques for forecasting is intended to increase the effectiveness and effectiveness of wind energy systems. Reliable wind speed prediction is necessary for increased wind energy system efficiency. In this article, we suggest an article on marine predator-optimized convolutional deep belief network (MP-CDBN) for wind speed prediction. After the MP-CDBN architecture has been trained using historical wind data, it is optimized utilizing the MPO approach.

## 2. Materials and Methods

The suggested model for predicting wind speed was created using a combo of Marine Predator and convolutional deep belief network (MP-CDBN), which was chosen. This particular combination is employed for the very first time in wind speed prediction, as was previously indicated. In additional research that included deep learning techniques, it was also tried with combos. This section provides detailed explanations of the structures that make up the suggested hybrid approach, data collection methods, and data preparation techniques.

### *2.1. Data set*

The wind speed information from the Changma wind farm in China (Zhang et al 2020) is used as a simulation to test the technique's capacity to forecast the wind speed of a genuine wind field. Every 20 minutes, the wind field gathers a wind speed reading, with a daily maximum of 144 readings. Four thousand four hundred sixty-four wind speed readings from 31 days of information on wind speeds were used in this investigation. The wind farm's 31-day distribution of wind speeds graph is seen in Figure 1. The chart shows that the wind speed varies significantly, with a highest wind speed of roughly 34 m/s and a low wind speed of only 0m/s. These 31-day wind speed measurements were used in the studies presented in this study.

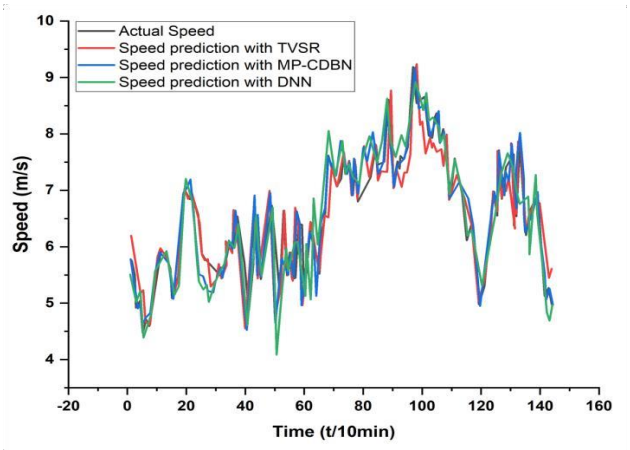


**Figure 1** Results of actual and estimated values.

*2.2. Preprocessiong*

To get an easier-to-understand outcome and remove noise-containing values from the segregated information, a normalization method was used from 0 to 1. To identify information sets for a more precise evaluation and to improve the effectiveness of the logistic procedure, the normalization step is crucial. The min-max normalization procedure is used to change the information structure into one that is more conventional. Equation (1) is used to normalize the data.

$$y' = \frac{y_j - y_{min}}{y_{max} - y_{min}} \quad (1)$$

Here, $y'$represents the normalized data;$y_j$ represents the data to be normalized; and$y_{Max} - y_{min}$represents the minimum value and the maximum value in the data, respectively.

*2.3. Marine Predators Algorithm*

MPA is a brand-new MA that was motivated by swarms and replicated the phenomena of marine animals searching for nourishment. In the water, both the Prey and the predator are looking for their next meal. Three stages are identified for the hunting procedure based on the speed relation between predator and Prey. In this case, the predator with the best hunting capacity is referred to as the elite. Like other swarm intelligence optimization algorithms, MPA's ultimate goal is to find the best answer (the elite) in accordance with the planned location updating techniques. The following is the precise execution:

Stage 1: When the predator's speed is greater than the Prey's, the predator waits and keeps an eye on the Prey's motion. This procedure takes place throughout the first third of repetitions, which is the MPA's discovery stage.

$$stepsize_j = K_P \otimes (Elite_j - K_B \otimes Prey_j) j = 1, \dots, m$$
$$Prey_j = Prey_j + B.K \otimes stepsize_j \quad (2)$$

Where P=0.5, Elite stands for the location of the elite, Prey for the location of the Prey, n for the group's dimensions, RB for a vector determined by Brown's law of attraction, and R for an arbitrary number in the range [0, 1].

Stage 2: Prey moves in a Brownian motion when its speed is equal to that of the predator, whereas elites fly in a Lévy motion. This procedure takes place in the MPA's discovery and utilization stages in the middle of iteration. Discovery is carried out by half of the people utilizing (3). The other half is in charge of (4)'s commercialization.

$$stepsize_j = R_L \otimes (Elite_j - K_F \otimes Prey_j) j = 1, \dots, m$$
$$Prey_j = Prey_j + B.K \otimes stepsize_j \quad (3)$$

$$stepsize_j = K_P \otimes (K_B \otimes Elite_j - Prey_j) j = 1, \dots, m$$
$$Prey_j = Elite_j + B.VL \otimes stepsize_j \quad (4)$$

Where $R_L$ represents a vector based on Lévy flight, and$F = (\frac{1-t}{t_{max}})^{(\frac{2-t}{t_{max}})}$.

Stage 3: The predator moves more quickly than the victim in the final third of repetitions. The algorithm's exploiting step has been expanded considerably.

$$stepsize_j = K_F \otimes (K_F \otimes Elite_j - Prey_j), j = 1, \dots, m$$
$$Prey_j = Elite_j + B.VL \otimes stepsize_j \quad (5)$$

The impacts of Fish Aggregating Devices (FADs) are taken into account by the MPA as an extra to the previous three stages. Equation (6) is utilized to model the chance of the Prey jumping from one habitat to another. It can successfully stop the algorithm from becoming stuck at the nearby optimal.

$$Prey_j = \begin{cases} Prey_j + CL[y_{min} + K \otimes (y_{max} - y_{min})] \otimes W \\ Prey_j + [FADs(1-K) + K](Prey_{k1} - Prey_{k2}) \end{cases} \quad (6)$$

Where FADs=0.2, $y_{\min}$ and $y_{\max}$ represent the lower and upper boundaries, $k1$ and $k2$ represent two random indexes of the Prey. If the random number in [0, 1] is less than FADs, then U =0; otherwise, U =1.

*2.4. Convolutional Deep Belief Network (CDBN)*

The basic "Convolutional Restricted Boltzmann Machine" (CRBM) comprises an input layer V, and a hidden layer H. The hidden layer consists of K groups, with each group represented as$M_Z \times M_Z$array of binary units, resulting in a total of $M_Z^2 R$ hidden units. Each group in the $R$ groups corresponds to a $M_U \times M_U$filter, where $M_U$is determined as $M_c$ - $M_Z$ + 1. The

same set of filter weights is utilized for all hidden units within each group. Moreover, a bias term $p_r$ is linked to each group of hidden units, whereas all visible units collectively share a bias term. The primary objective during the training of a CRBM is to minimize the energy function$(c, z)$, which is defined as:

$$A(c,z) = -\sum_{r=1}^{R}\sum_{i=1}^{MZ}\sum_{g=1}^{MU} z_{j,i}^{r}\, U_{kg}^{r}\, c_{j+k-1,i+g-1} - \sum_{r=1}^{R} p_r \sum_{j,i=1}^{MZ} z_{j,i}^{r} - v\sum_{j,i=1}^{MC} c_{ji} \quad (7)$$

We may use the following types of conditioned probabilities to apply Gibbs sampling:

$$B(z_{ji}^{r} = 1|C) = \sigma\left((\tilde{U} * c)_{ji} + p_r\right) \quad (8)$$

$$B(c_{ji} = 1|z) = \sigma((\textstyle\sum_r U^r + z^r)_{ji} + v) \quad (9)$$

Given the dataset D, the energy function is defined as follows:

$$A(T,U) = -\sum_{d\in T}\sum_{r=1}^{R}\sum_{j=1}^{MZ}\sum_{k,g=1}^{MU} z_{ji}^{r,d}\, U_{kg}^{r}\, c_{j+k-1,i+g-1}^{d} - \sum_{d\in T}\sum_{r=1}^{R} p_r \sum_{j,i=1}^{MZ} z_{ji}^{r,d} - v\sum_{d\in T}\sum_{j,i=1}^{Mc} c_{ji}^{d} \quad (10)$$

The max-pooling layer functions as an amplifier for signals. We may construct a convolutional deep belief network (CDBN) by layering many CRBMs over one another. For a binomial forecasting job, we apply the cross-entropy error function to the softmax structure. The cross-entropy damage rate is provided by, where YT is a set of labeled data points used to train the algorithm.

$$V(Z_D, \theta) = -\sum_{j=1}^{|ZD|}(x_j \log \hat{x}_j + (1 - x_j)\log(1 - \hat{x}_j)) \quad (11)$$

Backpropagation combined with the layer-wise unattended training technique can be utilized for training CDBNs.

## 3. Results

Practical tests were performed using the MATLAB application on a PC with an Intel i9 CPU, a 1750ti graphics card, and 64 GB of RAM.

The study's combination MP-CDBN method was separately utilized to estimate everyday wind speeds. The findings were assessed and summarized using measures of performance. Additionally, the TVSR and DNN network topologies were employed to evaluate the efficiency of the hybrid model used in the case study. The remaining parts provide a detailed presentation of the case study's findings.

Comparing the actual and estimated values using both proposed and existing methods, Figure 1 demonstrates that the proposed method exhibits superior accuracy in predicting wind speed compared to the existing methods. The estimated values obtained through the proposed method closely align with the actual values, affirming its effectiveness in wind speed prediction.

Root Mean Square Error is referred to as RMSE. It is a measurement of the discrepancy between the results of a logistic analysis' real and expected values. The RMSE is calculated as a square root of the mean of the proportional variations among the expected and real data. The RMSE of the suggested system is shown in Figure 2. While the proposed method achieves the desired MP-CDBN of 0.0116, TVSR has only reached 0.0346, and DNN has only achieved 0.0252. It shows that the proposed method of action is a minimum error than the existing method.

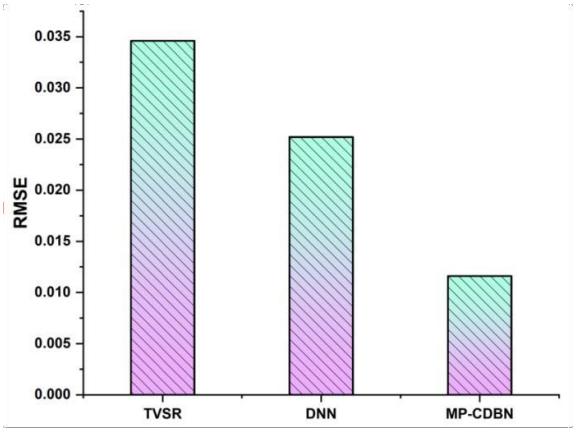


**Figure 2** RMSE.

$$RMSE = \sqrt{\left(\frac{1}{n}\right) * sum((y\_pred - y\_actual)^2)} \quad (12)$$

Where:

$y_pred$is the expected worth

$y_actual$is the actual value

$n$is the no of samples

Mean Absolute Percentage Error is referred to as MAPE. It is a way to gauge how accurately a number was predicted against how accurate it was. The average percentage difference between the actual and anticipated values, as compared to the actual value, is measured by MAPE. Figure 3 displays the MAPE of the recommended system. While TVSR and DNN have only attained 0.0456 and 0.0621, respectively, the suggested technique achieves the target MP-CDBN of 0.0201. It demonstrates that the suggested method of action has less error than the existing approach.

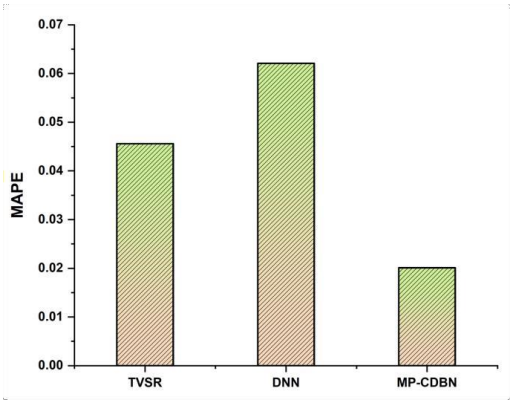


**Figure 3** MAPE.

$$MAPE = (\frac{1}{n}) * sum\,(abs\,\frac{(y\_actual - y\_pred)}{y\_actual}) * 100 \qquad (13)$$

R-squared (R2) is an indicator of how much variability in the variable of interest in a model of regression is caused by the variables that are independent. This evaluation metric is commonly used in the study of regression. R2 is a value that ranges from 0 to 1, where 0 indicates that there is no deviation from the variable that is dependent that can be explained by the variables that are independent, and one indicates that there is the entire variance in the centered measure that can be accounted by the variables that are independent. Figure 4 displays the recommended system's R2. While TVSR has only attained 0.862 and DNN has only hit 0.923, the suggested technique achieves the target MP-CDBN of 0.987. It demonstrates how successful the suggested technique of action is than the existing one.

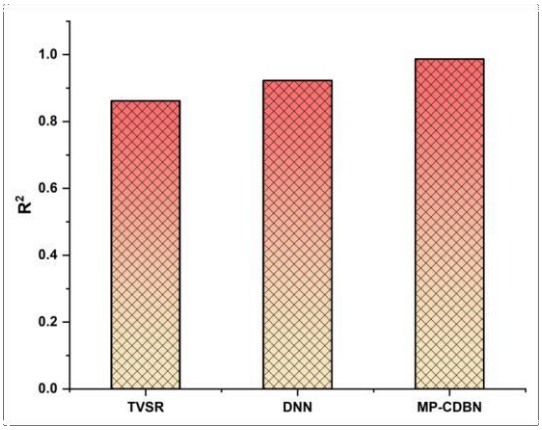


**Figure 4** $R^2$outcomes.

The formula for R2 is:

$$R^2 = 1 - (\frac{SSres}{SStot}) \qquad (14)$$

Where:

SSres is the total of the residuals' squares

SStot is the total of all squares

The ability of the model to accurately categorize or forecast a binary or categorical result is measured by its accuracy. It is the proportion between the number of accurate forecasts and the entire model's other forecasts. Figure 5 displays the accuracy of the proposed system. While TVSR has only attained 0.964 and DNN has only hit 0.892, the suggested technique

achieves the target MP-CDBN of 0.994. It demonstrates how the suggested plan of action is more successful than the existing strategy.

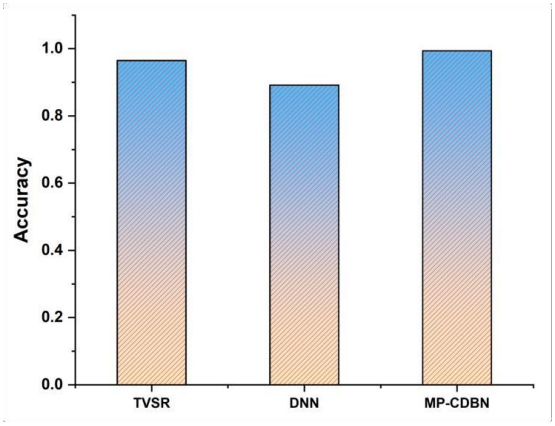


**Figure 5** Accuracy.

## 5. Conclusion

In this research, MP-CDBN was used to build the recommended model for forecasting wind speed. As previously mentioned, this particular combination is used for the first time to estimate wind speed. Utilizing wind speed information from the Changma wind farm in China as training dataset, the technique's capacity to forecast the wind velocity of a real wind sector is put to testing. The efficacy of the suggested hybrid approach was assessed by MAPE, R2, RMSE, and accuracy metrics. It was shown that the hybrid model produced better and more reliable findings (MAPE= 0.0201, RMSE= 0.0116, R2= 0.987, Accuracy= 0.994) than existing methods in wind speed prediction. The limitation of this research is that only a small number of the datasets are used. If a large dataset is used in the future, then we can enhance wind energy efficiency.

### Ethical considerations

Not applicable.

### Declaration of interest

The authors declare no conflicts of interest.

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Investigating the Influence of social factors on learning performance in collaborative learning environments

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**Abstract** Developing classrooms for active learning is a more popular component about higher education institutions' instructional efforts to interest and engage students in their academics. Social elements have been determined to impact student learning performance and participation in collaborative learning. This research examined social factors' capacity to encourage collaboration and participation and whether these concepts mediate in connecting social factors and student learning outcomes. The student's academic conduct has been observed using the constructivism theory. Students at universities completed surveys to provide that data. Results assessed using Structural Equation Modelling (SEM) show that societal factors, including connection, social connection, and usage of social media, improve active learning with peers also teachers, collaboration in Education, and participation of students, impacting educational performance. The results support this study's use of two-fold mediation. Online learning should be encouraged because it affects students' academic development in higher education institutions' teaching and learning. Collaborative learning and social component involvement have been found to enhance student learning activities.

**Keywords:** SLP, collaborative learning, online learning, SEM, social media, two-fold mediation

## 1. Introduction

Comparing the internet, we use today, Web 2.0, with those used in earlier times, 1.0, it is said that Web 2.0 is more interactive than 1.0. Additionally, the researchers note that interactive websites like Facebook, blogs, and YouTube are available on an internet connection nowadays. Students generally utilize social media to communicate with others in a social setting, claims. After focusing on researchers from a traditional perspective, higher Education now focuses on using social media in teaching and learning (Al-Rahmi and Zeki 2017). The number of university students has significantly expanded over the past several decades. When digitization started growing sphere of Education, it led to the advent of remote education techniques using digital technology. Parallel to digitalization, collaborative and transdisciplinary learning started to gain popularity in higher education, particularly in engineering programs, to prepare future experts to address increasingly complex, multi-stakeholder, and multi-perspective issues societies face today (Kalmar et al 2022). Student learning achievement is enhanced by collaborative learning. The essential technique for facilitating learning is as follows: In collaborative learning, students create and maintain a shared knowledge of their issue through social interaction. This assumes that students are aware of their thinking and those of their fellow group members and are communicating these perspectives to one another. Students must interact metacognitively, in other words. According to earlier studies, social contact connects to metacognition and supports effective learning. It fosters knowledge development, facilitates the adoption of practical techniques, and raises students' understanding of their own and others' learning processes (Haataja et al 2022). In computer-supported collaborative learning, there is growing academic interest in multilayered interface design to enhance purposeful interactions in online learning. In online learning instruction, multilayered interactions that encourage collaborative knowledge generation at individual and group levels have been emphasized. It has become possible to investigate collaborative learning beyond a certain level of an individual by using concepts of group cognition and collective cognitive responsibility (Zhang et al 2022). When interpreted broadly, communication is an interaction-enabling system that works together. Participants interact with one another in a group setting through active collaborative learning and content engagement, ideas, and technology. Students may become more engaged, improve knowledge and dialogue among peers, mentors, instructors, and professional assistants, consult specialists, and resolve difficulties due to social media's accessibility and usefulness (Alismaiel et al 2022).

The paper De et al (2022) developed regulators' online profile evaluations about asynchronous Computer Supported Collaborative Learning (CSCL) participants' application of Socially Shared and Individual-oriented Metacognitive Regulation

(SSMR). The paper Troussas et al (2023) proposes a system for recommending collaborative tasks to learners by utilizing a Weighted Sum Model (WSM) and an Artificial Neural Network (ANN). The paper Begum and Naga (2021) effects of Collaborative Learning (CL) based on Information Technology (ICT) on acquiring integrating abilities and driving among college students studying English as a Second Language (ESL). The paper Zabolotna et al (2023) develops analytical techniques that make it possible to monitor Computer Supported Collaborative Learning (CSCL) processes for a deeper understanding as well as constructing instructional tools to promote regulation and Knowledge Construction (KC). The paper Bächtold et al (2023) focused on cooperative learning activities about group work. Its goal is to ascertain how much students' past group work experiences, study habits, and learning styles influence these attitudes and beliefs. The paper provides methodological, theoretical, and valuable recommendations to further social learning analytics research, tool development, and implementation (Kaliisa et al 2022). The paper Lin et al (2022) examined connections between quality characteristics, three different forms of interactions, Information System (IS) success paradigm, and one example of a flipped classroom measuring perceived learning and learning satisfaction with flipped courses. The paper Luo et al (2022) proposed that a pleasant learning environment might increase students' involvement in online learning and feelings of belonging. The article Su and Zou (2022) developed on collaborative language learning contributed by educational technology has drawn more and more attention from students, teachers, and researchers. Many studies have examined an effects of technology-enhanced collaborative learning on students' language learning also emotional health. The paper Zabolotna et al (2023) presented students' opinions regarding group learning settings, their courses, group cohesiveness, and academic success as affected by gamification.

## 2. Materials and Methods

### *2.1. Development of a hypothesis*

- H1: Peer interaction significantly affects active collaborative learning.
- H2: Teacher connection has a significant impact on collaborative, active learning.
- H3: Active, collaborative learning is significantly impacted by social presence.
- H4: Social media use has an important impact on active, collaborative learning.
- H5: Students' involvement is strongly impacted by active collaborative learning.
- H6: Learning performance is significantly impacted by student engagement.
- H7: Social aspects and students' participation are mediated through active collaborative learning.
- H8: Active collaborative learning, social aspects, and academic success are all mediated by student engagement.

### *2.2. Research design*

Figure 1 shows a suggested framework, including social interactions, social media interactions, engaging learners in active, collaborative learning, interactions with classmates and teachers, and other intervening factors. Learning outcomes are dependent variables. Through mediation, a part of engagement and collaborative learning, the framework presents variables that seek to study how social aspects affect students' learning performance.

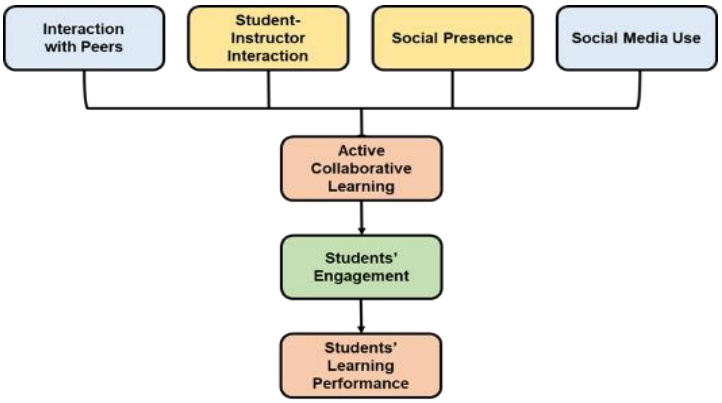


**Figure 1** Study's conceptual framework. Source: The authors' composition.

Operationally, variables were described as having explicit knowledge and following precise measurements:

- Collaborative learning: pertains to circumstances in which students do joint activities while each member uses the other's resources and talents.
- Present in society: a psychological limit that a student may feel is alternative students' current connection.
- Student participation: impression about a student such as comes against interactions with peers and teachers while learning.

- Participation of peers: enhances active learning and information processing through involvement, discussion, and peer education.
- Interaction with teachers: enhances ties between instructors and students by enabling teachers to give feedback to students and help them with their problems.
- Social media use is an online application that establishes and exchanges information through movies, images, and textual documents.
- Learning performance: the modification of potential and ability to engage in conduct.

### *2.3. Instrumentation and data collection*

All areas were assessed using a 5-point Likert scale except social presence, spanning from strongly opposing to supporting, which was evaluated using a Likert scale with seven points. The research method adopted was quantitative; therefore, data were gathered using a survey questionnaire that examined features of this targeted population; numerous demographic questions and interactive subjects with closed-ended questions were included. There are 34 items in it since a study has seven variables. The survey's questions have been modified. 400 Iqra University students received an online questionnaire using a convenience sample method. There were 398 online questionnaires, and students from various fields at Iqra University in Karachi completed 398.

Consequently, its sample size is 398. A sample size standard of 300 or more was suggested, according to a benchmark. The survey's questions were derived from those used in earlier research. The peer interaction and collaborative active learning questions were developed from two studies. The first research included three modified peer interaction items, two changed functional collaborative learning items, and the final two components of active collaborative learning and peer engagement.

Three different student engagement-related items and one social media-related item were all modified. While three social media items, interactions between students and teachers, learning outcomes, four student-instructor interaction elements, and four learning performance items were limited. Social presence inquiries. Four different components were modified in total. The following four student engagement-related factors were included: Participants' self-esteem will not be harmed by the information obtained for this study, which is intended to accomplish its primary goal.

### *2.4. Subtopic title*

The “Statistical Package for Social Sciences (IBM SPSS 22)” produces a demographic summary using descriptive statistical techniques like frequencies. SMART PLS 3.2.3 program for structural equation modeling (SEM-PLS) is another statistical approach employed in this work to analyze a route model's valid, convergent, and discriminant properties. It also included a bootstrapping technique.

### *2.5. Subtopic title*

Table 1 analyses the respondents' age groups, genders, and educational levels. According to the results, 39.4% of all 398 respondents are under 18, 52.3% are between the ages of 22 and 25, 7.0% are between the ages of 26 and 29, and just 1.3% are over the age of 29. The gender breakdown among 398 respondents was as follows: 63.3% were men, and 36.7% were women. Additionally, each responder's educational background was scrutinized. According to respondents' academic backgrounds, 69.8% were undergraduate students, 19.1% were graduates, 10.1% were postgraduate students, and more than 1.0% had degrees in various educational specialties.

**Table 1** Responder’s profile (N = 398).

| Demographic items | Percentile | Frequency |
|---|---|---|
| Age | | |
| 18–21 | 39.5 | 158 |
| 22-25 | 52.4 | 209 |
| 26.29 | 7.1 | 29 |
| Above 29 | 1.4 | 6 |
| Gender | | |
| Male | 63.4 | 253 |
| Female | 36.8 | 147 |
| Education | | |
| Undergraduate | 69.9 | 279 |
| Graduate | 19.2 | 77 |
| Postgraduate | 10.2 | 41 |
| Other | 1.1 | 5 |

## 3. Results and Discussion

Using the program Smart PLS 3.2.3, the study's data were examined. The recommended measurement and structural model were tested using a research model (PLS-SEM).

### *3.1 Subtopic title*

The evaluation model looks at the connection between measurements of latent variables. As stated, some tests were conducted in this study using a model's validity and reliability. Convergent an discriminant validity of measurement models do evaluate using Smart PLS-3. As shown in Table 2, Cronbach's alpha, composite reliability, and Average Variance Extracted (AVE) are used to determine measured items' convergent validity. They are examining its internal survey questions using Cronbach's alpha. When evaluating dependability, "composite reliability" with "AVE" determined that alpha should be more significant than 0.7. Reliability should be greater than 0.7, according to the composite value.

**Table 2** Model for measurement.

| | Items | Items Loadings | Cronbach's alpha | Average variance extracted (AVE) | Composite reliability |
|---|---|---|---|---|---|
| Active collaborative learning | ACL1 | 0.825 | 0.835 | 0.669 | 0.890 |
| | ACL2 | 0.799 | | | |
| | ACL3 | 0.829 | | | |
| | ACL4 | 0.819 | | | |
| Social presence | SP1 | 0.858 | 0.840 | 0.677 | 0.894 |
| | SP2 | 0.817 | | | |
| | SP3 | 0.850 | | | |
| | SP4 | 0.763 | | | |
| Student-instructor interaction | SII1 | 0.82 | 0.833 | 0.666 | 0.889 |
| | SII2 | 0.849 | | | |
| | SII3 | 0.823 | | | |
| | SII4 | 0.782 | | | |
| Students' engagement | SE1 | 0.702 | 0.777 | 0.817 | 0.900 |
| | SE2 | 0.89 | | | |
| | SE3 | 0.792 | | | |
| | SE4 | 0.895 | | | |
| | SE5 | 0.914 | | | |
| Social media use | SMU1 | 0.900 | 0.819 | 0.735 | 0.893 |
| | SMU2 | 0.836 | | | |
| | SMU3 | 0.836 | | | |
| Students learning | SLP1 | 0.820 | 0.789 | 0.826 | 0.905 |
| | SLP2 | 0.827 | | | |
| | SLP3 | 0.909 | | | |
| | SLP4 | 0.910 | | | |
| Interaction with peers | IWP1 | 0.737 | 0.848 | 0.622 | 0.892 |
| | IWP2 | 0.832 | | | |
| | IWP3 | 0.790 | | | |
| | IWP4 | 0.788 | | | |
| | IWP5 | 0.795 | | | |

Additionally, advise that an AVE acceptance threshold be more significant than 0.5. As can be seen, this study has met all three requirements. The product loading weights in corresponding latent variables were found to be larger than or equal to 0.5. Additionally, two items related to student involvement, two things related to student learning outcomes, and also a social media use item were eliminated throughout the analysis as shown in Figure 2, Figure 3, and Figure 4.

Cross-loadings, AVE, and HTMT were utilized into look at discriminant validity after convergent validity. Each construct's initial value should be bold, indicating a square root for that expression. When diagonal values in linked columns and rows outweigh non-diagonal values, they are considered legitimate values. A latent variable's discriminant validity assesses how different it is from other model variables. Validity for discrimination has been established, as shown in Table 3, since non-diagonal values are lower than all. The later step is to look for cross-loadings; Table 4 shows that constructs have values of 0.85, 0.9, or below, demonstrating that they display their HTMT ratio and discriminant validity.

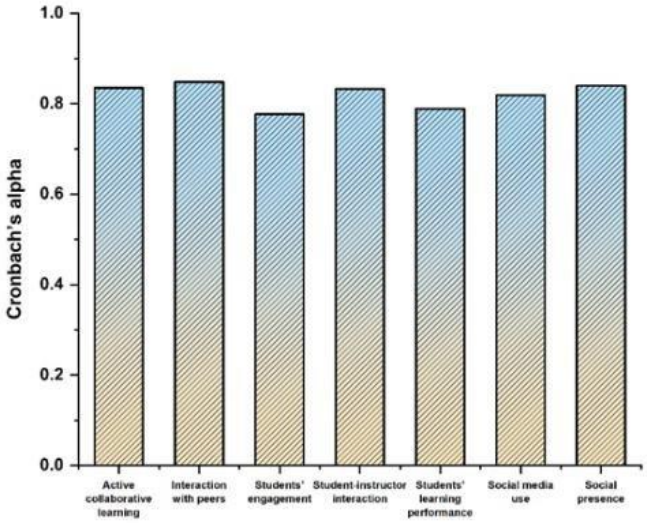


**Figure 2** Cronbach's alpha.

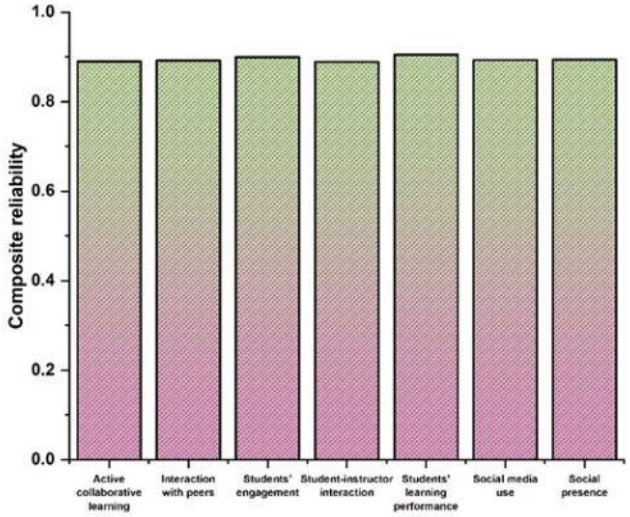


**Figure 3** Composite reliability.

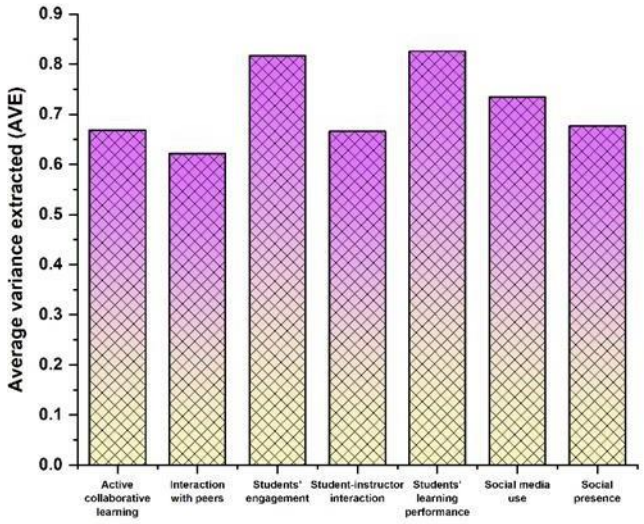


**Figure 4** Average variance extracted (AVE).

**Table 3** Disparate validity.

| | ACL | IWP | SE | SII | SLP | SMU | SP |
|---|---|---|---|---|---|---|---|
| ACL | 0.818 | | | | | | |
| IWP | 0.691 | 0.789 | | | | | |
| SE | 0.656 | 0.628 | 0.905 | | | | |
| SII | 0.665 | 0.647 | 0.540 | 0.816 | | | |
| SLP | 0.639 | 0.577 | 0.661 | 0.511 | 0.909 | | |
| SMU | 0.620 | 0.583 | 0.501 | 0.518 | 0.451 | 0.858 | |
| SP | 0.660 | 0.663 | 0.589 | 0.694 | 0.531 | 0.564 | 0.823 |

**Table 4** Heterotrait–monotrait ratio (HTMT).

| | ACL | IWP | SE | SII | SLP | SMU | SP |
|---|---|---|---|---|---|---|---|
| ACL | | | | | | | |
| IWP | 0.818 | | | | | | |
| SE | 0.810 | 0.775 | | | | | |
| SII | 0.798 | 0.771 | 0.672 | | | | |
| SLP | 0.790 | 0.707 | 0.843 | 0.631 | | | |
| SMU | 0.746 | 0.700 | 0.629 | 0.626 | 0.560 | | |
| SP | 0.786 | 0.785 | 0.728 | 0.831 | 0.653 | 0.678 | |

### *3.2 Architectural model*

That component of SEM that connects latent factors is a structural model. The connection patterns between each construct are identified using a structural framework. The bootstrap technique can be used to determine a structural model's result. Each structural model and hypothesis are examined using a path coefficient in PLS-SEM because it emphasizes every direct effects of independent variable on a dependent variable and uses a standardized regression coefficient. With 5000 subsamples, a bootstrapping approach was applied to assess the significance of connection coefficients. The path-coefficient criteria state that a relationship is significant if a p-value is less than 0.01. Table 5 shows that since every p-value is less than 0.05, all social elements have a favorable and substantial impact on active collaborative learning. Additionally, active collaborative learning has an large also advantageous impact on student involvement a significant that favourable impact about student's academic success. These include H1, H2, H3, H4, H5, and H6 therefore approved. Every indirect impact of all social elements on students' involvement has been investigated in Table 6, and it was discovered that active collaborative teaching mediators this link to some extent. According to research, if students learn through collaboration, interaction with classmates and teachers, and social media, use boosts student engagement. H7 has therefore been approved. Additionally, the mediation impact of student participation has been studied. The study shows that social presence, peer interaction, teacher contact, social media, and social presence all indicated greater levels of active collaborative learning, which predicted greater student involvement and, ultimately, better student learning outcomes.

**Table 5** Results of path analysis.

| Hypothesis | Regression path | SRW | Effect type | Remarks |
|---|---|---|---|---|
| H1 | IWP->ACL | 0.288*** | Direct effect | Supported |
| H2 | SII->ACL | 0.241*** | Direct effect | Supported |
| H3 | SP->ACL | 0.175*** | Direct effect | Supported |
| H4 | SMU->ACL | 0.231*** | Direct effect | Supported |
| H5 | ACL->SE | 0.656*** | Direct effect | Supported |
| H6 | SE->SLP | 0.661*** | Direct effect | Supported |

**Table 6** Results of mediation analysis.

| Hypothesis | Regression path | SRW | Effect type | Remarks |
|---|---|---|---|---|
| H7a | IWP->ACL->SE | 0.189*** | Indirect effect | Supported |
| H7b | SII->ACL->SE | 0.158*** | Indirect effect | Supported |
| H7c | SMU->ACL->SE | 0.152*** | Indirect effect | Supported |
| H7d | SP->ACL->SE | 0.115*** | Indirect effect | Supported |
| H8a | IWP->ACL->SE->SLP | 0.125*** | Indirect effect | Supported |
| H8b | SII->ACL->SE->SLP | 0.105*** | Indirect effect | Supported |
| H8c | SP->ACL->SE->SLP | 0.101*** | Indirect effect | Supported |
| H8d | SMU->ACL->SE->SLP | 0.075*** | Indirect effect | Supported |

## 4. Discussion

The proposed hypotheses were tested using SEM analysis, as was already established. The results support a model and assumptions proposed to explain how different variables relate. Figure 5 shows the hypotheses for six essential constructs. The findings confirmed every hypothesis. Activated collaborative learning and peer interaction are the topics of the first hypothesis. The results indicated a clear correlation between collaborative learning and peer interaction (r = 0.287, p 0.01). They prompted the authors to conclude that peer interaction is encouraged by collaborative learning, knowledge sharing, information exchange, also group discussions. Consistent results led researchers to conclude that student collaboration and active learning promote interaction.

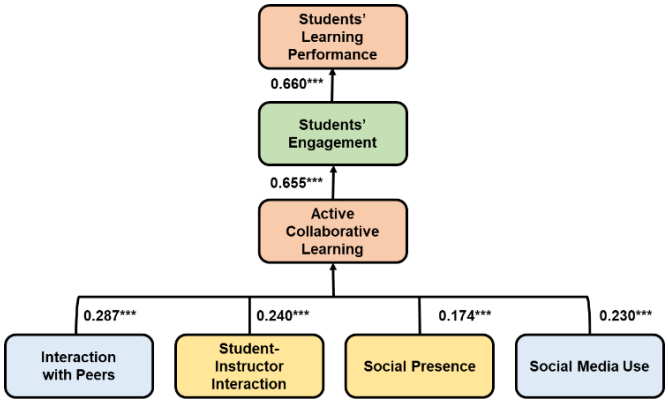


**Figure 5** Results of path analysis.

Additionally, a chance for peer connection and idea exchange fosters students is motivated to stay engaged throughout the learning process through a sense of belonging in collaborative learning. The second hypothesis discusses engaging in active, group learning while interacting with teachers. Because students prioritize their interactions with teachers and strongly prefer active, collaborative learning and teacher contact were positively and significantly correlated by findings (= 0.240, p 0.01). They suggested that facilitating interaction between students and instructors strengthens active collaborative learning. The connection between social interaction and active, cooperative learning is a different hypothesis. According to the findings, social interaction and engaged, collaborative Education are significantly and favorably related (β= 0.174, p 0.01). The research concludes that students will engage in active learning more when the group's social presence improves. Social presence has been acknowledged as crucial in helping students engage in active learning. According to a fourth hypothesis, social media usage and group learning are related. The study's results demonstrate a strong and positive association that there is a positive correlation between Social media use and active collaborative learning have a positive correlation (r = 0.230, p 0.01), and this improves performance.

Similar results suggest that social media may be used to promote collaboration and interaction among students. The connection between active learning and collaborative involvement is the subject of the sixth supposition. According to the findings, collaborative learning and participation allow students to access more resources and information, which enhances their academic success; this demonstrates an encouraging and robust connection between the two (β= 0.655, p 0.01). Similar conclusions were drawn from the data, which show that active learning raises students' levels of academic engagement. The last theory discusses a relationship between learning performance and student involvement. The study results show a substantial positive correlation between student involvement and learning outcomes (r = 0.660, p 0.01).

### *4.1. Analysis of mediation*

The impacts of student engagement in active team learning involvement as mediators among different factors are investigated. Every study first shows that active collaborative learning mediates engagement, social media use, interactions between students and teachers, and online presence. According to the research, collaborative learning is an effective teaching strategy since it motivates students to engage and collaborative. Students that actively collaborate during the learning process have higher levels of engagement. The results show that student involvement also mediates a relationship between variables. Every outcome supports the mediation effect that was the subject of this investigation. They conclude that critical factors influencing learning outcomes incorporate student participation and active, collaborative learning.

## 5. Conclusions

This investigation aimed to examine how social interactions and collaborative learning is impacted by social media use and visibility, which involves students and ultimately improves their learning capacity. Every research backs up each relationship in the predictive framework. The study's conclusions help us understand how university students learn, interact

with their classmates and professors, and engage in collaborative learning and social presence on social media. However, the findings suggest that peer group instruction is advantageous for pupils since it may provide high-caliber results. Collaborative learning for students develops solid thoughts, group ideas, conversations, and interactions with classmates. When students interact with teachers, they get technical assistance and academic guidance, reflected in their behavior and work product in the student workgroup. Face-to-face cooperation is less successful than online collaboration.

Additionally, findings demonstrate a strong and advantageous relationship between student involvement and active, collaborative learning. Students learning performance does eventually improve since, through group learning and participation; they might have access to more resources and data. Findings from this study's investigation of cooperation and involvement also support the use of constructivist theory. The results demonstrate that involvement and cooperation improve learning outcomes by including social variables in group discussions. The collaborative learning style encourages students to actively participate in their Education to benefit their future careers. The study's findings confirm it and establish social elements as predictors of active collaborative learning. Therefore, for enhanced generalizability of outcomes, sample populations in future research should be drawn from various nations and areas. One restriction is the study's consideration of social elements, such as the Influence of collaborative learning that is active. Future research also considers other factors, such as the social interaction of the instructors, various aspects of student involvement, use of learning outcomes as the dependent variables.

**Ethical considerations**

Not applicable.

**Declaration of interest**

The authors declare no conflicts of interest.

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Examining academic members' interaction and information-sharing patterns in higher education

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**Abstract** The researchers needed to figure out how employees at least one or two schools and colleges in Urdaneta City, Pangasinan share data with each other. The data were analysed using chi-square, thematic analysis, weighted average mean, frequency and percentage analysis, and average weighted mean. It was discovered that the bulk of the responses are controlled who are between the ages of 18 and 38, are male in sex, work as part of the college of education at open Access to Higher Education Institutions (HEI), and access or check their Facebook accounts anywhere from once per day to three or more times per day. In the classifications of teaching and learning, current events and news, entertainment, fitness, and love and family, the overwhelming majority of participants were driven by an interest in retrieving information via their like. According to the findings of the research, the manner in which individuals share information may be influenced by factors such as age, the kind of higher education received, the course group, and the amount of time spent using social media. As a tool for education and training, Facebook is by far the most popular social networking site (SNS) to utilize. In addition, the respondents' top choices for contributing to the cooperation of instructors include the chatting function, the feature that allows for the exchange of information, and the page feature. In spite of this, ethical concerns were brought up about the usage of social networking sites.

**Keywords:** Information sharing, higher education, SNS, behaviour, academic members

## 1. Introduction

The use of social media by colleges and universities to increase their exposure to prospective students, increase interactions between users (including prospective students, alumni, and donors), examine the effects of social media on college marketing practices, and examine the types of marketing information are just a few recent social media marketing studies that have focused on this topic (Lund and Wang 2020). Student success and learning are greatly aided in higher education by interaction and information-sharing patterns. These structures relate to the interactions and information sharing that takes place between students and teachers in a variety of learning places, including conventional classroom settings, online learning environments, and hybrid models that integrate both techniques (Battistelli et al 2019).

In addition to improving critical thinking abilities, knowledge retention, and overall academic achievement, effective interaction and information-sharing patterns may contribute to the creation of a more engaging and collaborative learning environment. Additionally, by creating possibilities for social and emotional development alongside academic success, these students may gain a sense of support and belonging through patterns (Gebreyohans et al 2022). The sharing of information in higher education aims to increase students and their families' access to and transparency of the higher education application and admissions process. Colleges of higher learning may assist students in making wise choices about their educational and professional routes by offering accurate and current information (Beardsley et al 2019).

To guarantee that all students have equitable access to educational resources and possibilities, effective information sharing in higher education necessitates cooperation between institutions, policymakers, and other consumer teachers. A fascinating area of study for the academic community is how university students utilize social media to share knowledge. Worldwide studies have been conducted to assess the level of student usage of social media and information-sharing behaviors (Bashir et al 2021). The many ways that people and groups interact and exchange information within the higher education system are referred to as communication and information-sharing patterns. Students, instructors, staff, administrators, and other parties with interest in higher education, for example, communication and information exchange, may fall under this category (Sun et al 2021). The present college students and instructors have grown dependent on social media as a method of interaction since they were raised in a technologically advanced world that met their social needs (Wong et al 2022). However, the investigations excluded colleges and the kind of institution that would have marked a boundary in students' information-sharing behavior.

Researchers, students, and administrators are drawn to the Internet of Things (IoT), a quickly developing educational technology. In order to ascertain if higher education institutions (HEIs) have prospective cultures of interaction and sharing of data, the chapter examines the possibilities and problems presented by the IoT (Ali 2021). The systematic review offers a summary of empirical studies on the use of AI in online higher education. This review specifically looks at how AI operates in empirical research, the algorithms utilized in empirical research, and the results and implications that come from empirical research (Ouyang et al 2022). García-Holgado and García-Peñalvo (2022) Introduced the Women into Science, Technology, Engineering and Mathematics (W-STEM) model, which is the result of three years of research into approaches and plans for enhancing the procedures of attracting, gaining entry to, guiding, and retaining women in STEM programs.

Abbas et al (2019) investigated the good and negative influences on students' brains, as well as how they influenced their ability to communicate both happy and bad experiences with others. It is becoming more obvious that social networking sites and the apps they provide university students both huge advantages and threats and that their effects on students' psychological adjustments or learning practices are not well known. Students may now submit material aimed at external audiences or audiences other than the teacher, according to the article employed by information communication technologies (ICTs). Since they are public and exist outside of the classroom, these audiences are referred to as genuine audiences (Lynch et al 2022).

Alshehri and Cumming (2020) determined how Knowledge Management (KM) among students and instructors in higher education settings in Saudi Arabia is impacted by the inclusion of mobile devices. Two institutions conducted interviews with instructors and students to learn more about the variables influencing the usage of mobile technology for learning. Ozdamli and Cavus (2021) approach is selected in order to get in-depth comments from college students on knowledge sharing and related technologies in Northern Cyprus. Sixty-nine students from the Computer Information Systems department who were enrolled there during the 2017–2018 academic year make up the study group for the study. It has been shown that students in the Department of computer information systems often utilize knowledge-sharing tools. The usage of face masks in the context of COVID-19 is discussed in this paper, along with an empirical investigation of information-sharing habits on Twitter. People's knowledge and views, which are in turn impacted by the information at their disposal, often have an impact on behavioral changes, such as the usage of face masks. At the start of the COVID-19 epidemic, face masks were not advised for usage by the general population in the UK (Dai et al 2022).

Zhan et al (2022) examined the dilemma of supply chain participants making decisions under there are four different information-sharing scenarios: total information sharing, forward information sharing, backward information sharing, and non-information sharing. We refer to the impacts of strategy and agility, which are produced by forecasting information, on choices about wholesale prices and product quantities, in our model. (Gupta et al 2022) conducted a primary survey on the adoption and usage of information and communications technology (ICT) by academicians in their teaching methodologies, particularly in higher educational institutions in the Delhi National Capital Region. Liu et al (2022) designed a block chain-enabled safe data-sharing architecture that can accommodate a distributed community of different stakeholders. Afterward, we turn the issue of data sharing into a challenge pertaining to machine learning by introducing a sort of federated learning that protects users' privacy. Sharing the data model rather than disclosing the actual data is an effective way to protect the confidentiality of the information.

## 2. Materials and Methods

In this section, we discuss the academic members' interaction and information-sharing patterns in higher education. Collaboration, communication, and knowledge exchange are essential elements of good learning outcomes and may be promoted through effective interaction and information-sharing patterns among academic members. Academic members may communicate with one another via many different means, including face-to-face encounters, email conversations, online debates, and collaborative platforms.

### *2.1. Population and Study Location*

Convenience sampling was the best choice since the researcher needed to quickly acquire the questionnaires from a selection of Urdaneta City's HEIs in order to collect data. In contrast, Slovin's formula took into account the type of institution of higher learning, the study group, and the use patterns on social media to calculate the sample size. It also included steps to (1) assess the respondents' information-sharing habits in the contexts of entertainment, health, education, and instruction, and love and family news and current events; and (2) analyze the connection between the respondents and the information sources. The other three HEIs were unable to participate, thus, the researcher decided to just take into account six of the nine.

### 2.2. *Data Collection*

The researcher created the questionnaire that was used to collect the data. The reliability of the set of questions was evaluated by a pilot test. The target demographic was chosen at random, and 33 Urdaneta City University professors were

chosen. They were obligated to respond to the questionnaire. Test for the dependability coefficient, in particular Cronbach's Alpha, which is a means to gauge a measure's consistency, was used in the Statistical Package for the Social Science (SPSS) Program version 23.0 to determine an analysis of item dependability. The exam only needed to be administered once, and the79 items' alpha coefficient was 0.959, demonstrating adequate dependability and consistency. This demonstrates that the survey questions were entirely suitable for the intended study.

2.3. *Processing of Data*

The use of social media by age, sex, course group, kind of higher education institution, and frequency, as well as the frequency and percentage formula used, is the first issue with the profile. The weighted mean method was used as stated for the second issue of two, which concerned people's information-sharing habits in the health, family, love, news, and current events categories, entertainment and instruction, and education and instruction. The chi-square formula was used as demonstrated to solve issue three, which associated the association among the participant's demographic information-sharing patterns among several factors in the areas of teaching and learning, entertainment, news and current events, fitness, and love and family. Finally, the fourth issue was solved via theme analysis. The equation is written as:

$$Y^2 = \sum \frac{(P_j - F_j)^2}{F_j} \qquad (1)$$

Where $Y^2$ =Chi squared

$P_j$=observed value

$F_j$=expected value

The chi-square formula is used to assess if there is a significant difference between the observed distribution of categorical data and the distribution that would be predicted under the null hypothesis. The crucial value from a chi-square distribution with degrees of freedom equal to the number of categories minus one is compared to the chi-square test statistic. The null hypothesis is disproved if the chi-square test result is higher than the threshold value, demonstrating a substantial discrepancy between the observed and anticipated frequencies of the categorical variable.

## 3. Results

In this section, we discuss the findings of the Information sharing in higher education refers to the dissemination and exchange of knowledge, data, research findings, and resources among individuals and groups within the academic community. It encompasses the sharing of educational materials, research papers, digital content, and relevant information that contributes to the learning, teaching, and research activities within higher education institutions.

**Table 1** The Profiles of the Respondents.

| | % | PROFILE | f |
|---|---|---|---|
| Age | 72 | 18–38 | 116 |
| | 23 | 39–53 | 37 |
| | 8 | 54–72 | 13 |
| Sex | 53 | Male | 85 |
| | 49 | Female | 78 |
| Course Group | 16 | Social Science | 26 |
| | 5 | Natural Science | 7 |
| | 22 | Formal Science | 35 |
| Frequency of Use | 41 | 1–3 times a day | 66 |
| | 33 | 4–6 times a day | 53 |
| | 11 | 7–9 times a day | 17 |
| | 19 | Ten times or more | 31 |
| Type of Institution | 85 | Public | 138 |
| | 17 | Private | 27 |

*3.1. The Respondent's Profiles*

The number of male and female respondents is one of the profiles that can be observed in table 1. It should be mentioned that 52% of the participants are men, while the other 48% are women. This will allow it to be assumed that there was a nearly distribution equally of replies to the sex-related questions during the course of the distribution of the study. The table also shows the type of higher education institution to which the participants involve in the profiles. It is evident that the bulk of respondents, 84% belong to public higher education institutions, with the remaining 16% attending private HEIs. Education, Formal Science, and Social Science had the highest percentages within the subject category, with 26%, 21%, and

15%, accordingly. This follows by engineering (12%), business (9%), health science (7%), and natural science (4%), in that order, with the remaining responders. Furthermore, just 2% of the participants from the architecture and design, humanities, and media and communication course groups, as well as none from Public Ad, Transportation, Agriculture, and Nutrition, were among the course categories that had the fewest responses.

**Table 2** Five types of respondent's information-sharing behavior.

| CATEGORIES | POSTING | | SHARING | | LIKING | |
|---|---|---|---|---|---|---|
| | WM | DE | WM | DE | WM | DE |
| Education and Instruction | 2.14 | Sometimes | 2.56 | Often | 2.61 | Often |
| Entertainment | 1.89 | Sometimes | 2.22 | Sometimes | 2.44 | Sometimes |
| Current news and events | 2.03 | Sometimes | 2.32 | Sometimes | 2.53 | Often |
| Health | 2.08 | Sometimes | 2.44 | Sometimes | 2.66 | Often |
| Love and Family | 2.07 | Sometimes | 2.35 | Sometimes | 2.57 | Often |
| AWM | 2.05 | Sometimes | 2.36 | Sometimes | 2.57 | Often |

*3.2. Five Categories of respondents' information-sharing behavior*

The outcomes of the way respondents shared information across all five classifications are shown in Table 2. It is important to emphasize that appreciation a weighted average overall mean of 2.55 across all information-sharing behaviors, which is considered as often, whereas sharing and publishing received weighted average overall means of 2.36 and 2.03, accordingly, which are descriptive similar of occasionally. This implies that the majority of the participants liked the categories on many different occasions, with the exception of the entertainment category, which received a weighted average of 2.43 and was classified as sometimes. The majority of respondents preferred to just inform the public that they enjoyed the piece without leaving a comment, according to the statistics shown below. Education and teaching are often the topics that respondents enjoy and discuss the most across every field. Following in decreasing order are: wellness, family and love, information about the world, and current events. The hypothesis that participants prefer distributing posts rather than liking and submitting on social media in all areas, especially in the fields of Education and Instruction (Eand I), Entertainment (ET), given all the information collected, would indicate that news and current affairs, health, and love and family are rejected.

**Table 3** Age-related differences in information-sharing behavior.

| Indicators | Age and Information Sharing behavior |
|---|---|
| E and I, Liking | 11.75 |
| E and I, Sharing | 5.14 |
| E and I, Posting | 17.57 |
| ET, Liking | 21.05 |
| ET, sharing | 36.93 |
| ET, Posting | 35.37 |

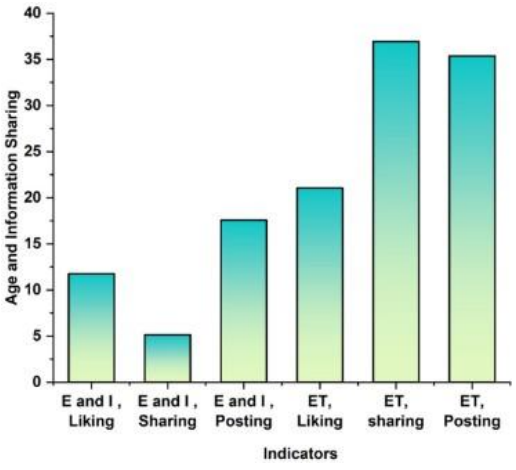


**Figure 1** Age-related differences in information-sharing behavior.

### *3.3. The Respondent's Relationship Age and Social Media Information-Sharing Behavior*

The relationship between the two profile variables, age, and the respondent's shared information procedures, is presented in figure 1 and Table 3. This shows that the respondents' information-sharing actions strongly correlate with their age when submitting issues on Education and Instruction (E and I), sharing, liking, and posting about Entertainment (ET), sharing, liking, and posting about news and current events, liking, distributing, and submitting about health, and liking, sharing, and posting about politics. Based on their age, people often enjoy, share, and publish in five main categories.

**Table 4** Information sharing and sexual behavior.

| Indicators | Sex and Information Sharing behavior |
|---|---|
| E and I , Liking | 2.64 |
| E and I , Sharing | 5.95 |
| E and I , Posting | 9.27 |
| ET, Liking | 10.07 |
| ET, sharing | 0.63 |
| ET, Posting | 2.66 |

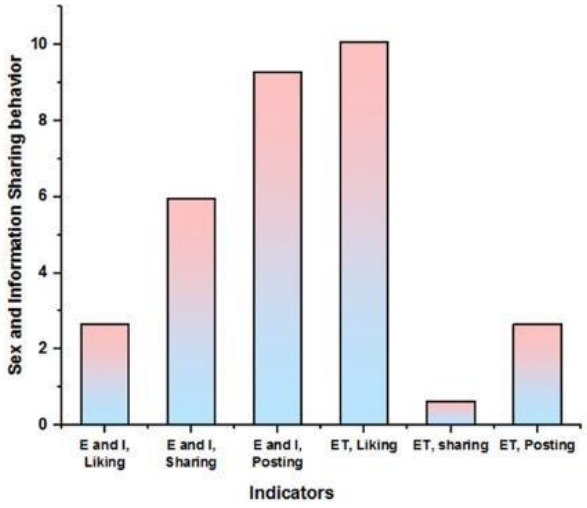


**Figure 2** Information sharing and sexual behavior.

### *3.4. Relationship among Respondents' Sexual Orientation and Information Sharing on Social Media*

The association between the profile variable sex and respondents' information-sharing habits is seen in figure 2 and table 4. These show a substantial relationship among the responders like behavior and their sex in favor of news and current events, entertainment, and health-related themes. But when it comes to enjoying themes about education and teaching and issues about love and family, sex does not seem to be significant. These show that issues relating to education and teaching, as well as love and family, are popular among the respondents, whether they are male or female.

**Table 5** HEI and information-sharing behavior relationships.

| Indicators | HEI Type and Information Sharing behavior |
|---|---|
| E and I, Liking | 22.04 |
| E and I, Sharing | 19.47 |
| E and I, Posting | 14.75 |
| ET, Liking | 22.92 |
| ET, sharing | 36.12 |
| ET, Posting | 23.87 |

### *3.5. Connection between the HEI Type and Social Media Information Sharing Behavior*

A relationship between the profile variable and type of institution and the respondent's sharing information habits is shown in figure 3 and table 5. Use networking websites to stay in contact with friends, make new ones, or track down old ones. However, other users have deeper motivations for frequenting the SNS, such as maintaining close ties with their families. With these various perspectives on the respondents' use of social media platforms, it can be deduced that there is

also variety in their use of social media platforms on a regular basis. The table displayed the respondents' like behavior across all categories, indicating a correlation between the respondents' frequent usage of their like behaviors and social media.

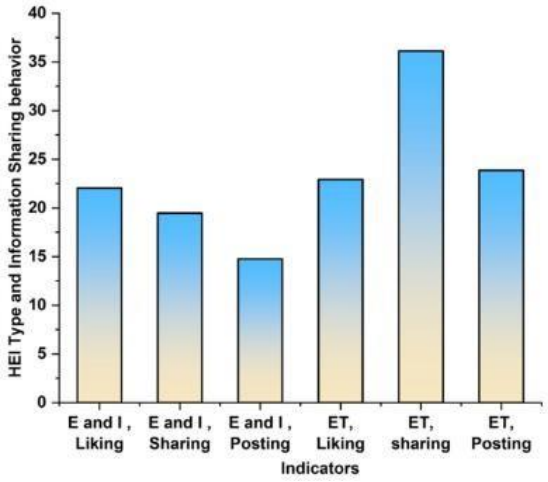


**Figure 3** Type of HEI and information-sharing behavior relationships.

**Table 6** Social media usage frequency and information sharing behavior.

| Indicators | Social Media and Information Sharing behavior |
|---|---|
| E and I , Liking | 34.11 |
| E and I , Sharing | 16.12 |
| E and I , Posting | 27.96 |
| ET, Liking | 32.62 |
| ET, sharing | 23.55 |
| ET, Posting | 28.38 |

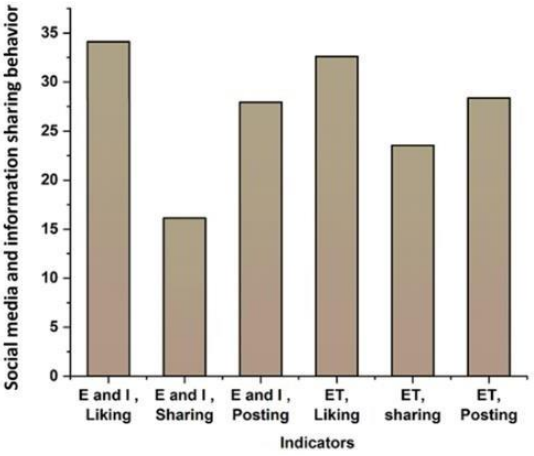


**Figure 4** Relationship among social media usage frequency and information-sharing behavior.

*3.6. Social media usage frequency and information sharing behavior*

The relationship between respondents' behavior in sharing information and the variable profile frequency of social media usage is shown in figure 4 and table 6. The results show that the respondents' frequency of visits may be attributed to a number of factors. According to the Uses and Gratification Theory, people, organizations, and society utilize media in various ways to meet their unique needs. These many user motivations persuade individuals to create an account in order to fulfill their demands. However, other users have deeper motivations for frequenting the SNS, such as maintaining close ties with their families. With these various perspectives on the respondents' use of social media platforms, it can be deduced that there is also variety in their use of social media platforms on a regular basis.

**Table 7** Issues with utilizing SNS in teaching and education.

| Issues | Percentage (%) |
|---|---|
| Privacy and Security | 15 |
| Distraction | 17 |

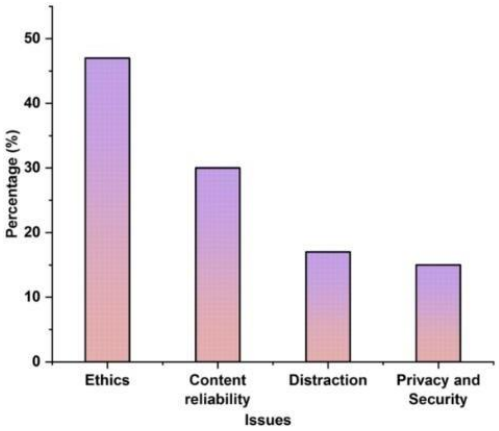


**Figure 5** Problems with utilizing SNS in teaching and education.

*3.7. SNS Issues*

The Social networking site use, notable Facebook, in the sphère of éducation and teaching is a topic that is covered in this article. The particular motivations for using SNS are presented in figure 5 and table 7. According to the data, the respondents' top concerns were ethics, which accounted for 47% of the total. Next in importance were content dependability (30%), distraction (17%), and privacy and security (15%).

## 4. Conclusions

The majority of the participants are driven by a need to find information, as seen by their interests in news, news, entertainment, health, family, and love. Inspiring quotes, phrases, and examples about the man's place in a relationship are more popular among the participants, who also expressed a preference for teaching strategies papers, beautiful location images, government-related breaking news, healthy lifestyle articles, and appropriate exercise techniques. The participant's information-sharing habits are influenced by their age, kind of usage of social media often, higher education, and course group. The participant's sex did not, however, influence their sharing information behavior in general, including sharing, loving teaching and education, love and family issues, and publishing amusement articles. The most popular social networking site (SNS) for education and teaching is social media. It allows quick data distribution, is accessible, encourages participation, and is the chosen medium for most students. Additionally, respondents preferred the chat tool, information sharing feature, and page feature as features that might aid in teacher cooperation.

## Ethical considerations

Not applicable.

## Declaration of interest

The authors declare no conflicts of interest.

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Examining the triple bottom line benefits of ecotourism: A multi-faceted approach

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**Abstract** This study assessed the economic (Ec), environmental (En), and social aspects (SA) of ecotourism (ET) in the Philippines in Lobo (LO) and Batangas (BT). The Verde Island Passage, where LO is located, is said to be the hub of marine biodiversity on earth. Another characteristic of LO is the 120-year-old Malabrigo Lighthouse, which views Verde Island. Tectona philippinensis trees, which grow in mountain ranges, are severely endangered in the Philippines. There are also fish sanctuaries, lovely beaches, and diving spots there.394 inhabitants of 18 barangays or local villages in the ecotourism regions (ETR), who were chosen by stratified-proportional random selection, provided their opinions. A survey questionnaire was used to acquire data for this descriptive research. Results indicate that ET in L is socially, commercially, and ecologically acceptable. To ensure the viability of ET over the long term, the local Lobo government (LLG) and the Tourist Sector(TS) should exercise continual caution in all aspects of development. Residents of the surrounding areas should also be constantly looking for methods to safeguard the Lobo Environment (LE) and preserve its natural resources, which should take precedence above any financial advantages that industry, tourism, or other sectors may be able to provide.

**Keywords:** economic aspects, sustainable development, community assessment, Lobo, social aspect, ecotourism

## 1. Introduction

The Economic (Ec), Environmental (En), and Social Aspects (SA) of ET are represented as the Triple Bottom Line (TBL). Due to its contribution to Local Economies (LE) and prosperity, tourism is one of the industries with the quickest growth rates internationally. Additionally, this fast expansion has socioeconomic implications, including environmental issues that many nations need to address. The most pressing problems are the tourism sector and the ecological harm visitors do, particularly in the natural regions that stand out for their delicate ecosystems and distinctive local cultural elements (Kaymaz et al 2021). The significance of the tourist sector is shown by its contribution to employment and economic development over the last few decades at a rising pace. Currently, it employs 292 million people globally, which equates to one in every ten employees (Teeroovengadum 2019). Elite entrapment, Poor Management (PM), Nepotism (Ne), intimidation, the failure of Local Participatory Processes (LPP), the removal of Donor Funding (DF), the removal of external support for capacity building, and lower revenues as a result of the unfavorable Macroeconomic Environment (ME) are also linked to the socioeconomic issues the Mahenye ET project later encountered after 2000 (Mudzengi et al 2021). Confusion and problems in planning tours to draw consumers and ensure customer satisfaction for ET have resulted from a need for more agreement on the nature of ET and its activities. Because these barriers could have been better planned and executed, they had a detrimental impact on visitors' experiences. This deficiency necessitates a fresh study round to find the elements that boost visitor pleasure and remove the ones that cause it (Thuy et al 2020). These TBL advantages demonstrate how nature-based tourism can significantly support endangered species conservation. They also show how recognizing individual decision heterogeneity might improve the ability to optimize the features and costs of this significant segment of the tourist business (Naidoo et al 2021).

The TBL, a theoretical framework for Corporate Social Responsibility (CSR) made up of economic, social, and environmental sub dimensions, serves as the foundation for the theory (Shim et al 2021). The research Ahmad and Wong (2019) provided comprehensive and weighted sustainability metrics for Malaysia's food manufacturing sector. The article Acep et al (2019) demonstrated if a corporation prioritizes its external environment's interests in addition to its own financial goals. As the first stage in the investigation of integrating the triple-bottom-line approach to event evaluation and the Big Data produced by participants, Cortese et al (2019) devised a circular and participatory monitoring strategy that uses technology to include all stakeholders. The article Gunesch (2020) philosophically connected sustainability, the TBL,

environmental communication, and slow and fast tourism. Community-Based ET (CBET) is a locally driven natural resource management based on the principles and actions of conservation (Mohd et al 2020). Travel and tourism, literature and lifestyle, and Sustainable Business Management (SBM) papers from the 1980s and 1990s were combined, contrasted, and studied fot Gunesch (2019). The research Wondirad et al (2020) utilized a qualitative research methodology to examine the benefits of two competing theories: Non-Governmental Organizations (NGOs) promote Sustainable Development (SD) or act as agents of neo-colonialism. The article Ranjith (2021) explored the idea of responsible tourism as one of the finest ET approaches for the present and the future. The research Rahman (2022) looked at how Malaysia's maritime protected areas (MPAs) are affected by the rise of ET from an economic, environmental, and social perspective. The article Rao and Saksena (2020) focused on the many tourism ideas connected by the same underlying philosophy that encourages travel for a purpose. The regional towns near the destinations take a good stance on environmental accounting. As a result, they could participate in programs for ecological conservation and accounting (Meera and Vinodan 2020). The research Newland et al (2021) used the World Tourism Organization's (WTO) Sustainability Indicators as a framework to investigate how athletic events and ET compare. The study Eshun and Tichaawa (2019) focused on raising ET development involvement to benefit the nearby community. The article Mulyani et al (2021) examined cooperative governance in developing sustainable ET in Magelang Regency, Central Java province. The ESQ and tourist satisfaction at Ethiopia's Bale Mountains National Park (BMNP) were examined in (Aseres and Sira 2020). The study Poponi et al (2020) emphasized the critical function of hiking guides as a powerful tool for spreading conservation messages to ET while advocating SD and adopting agro-environmental practices on the side of local populations.

## 2. Materials and Methods

The descriptive design - survey method is used in the current study. The faculty of a State University (SU) and professionals in the Batangas tourism industry (BTI) approved the researchers' questionnaire as the means of data collection. Thirty respondents from LO, BT, who are presently enrolled in school or engaged in Batangas City, participated in a questionnaire pilot study. The reliability study of the collected data produced a satisfactory Cronbach's alpha value of.7875.

The actual data for the research was gathered from 18 BT (villages) in LO, which has a population of 25,393 and is adjacent to ET regions. Three hundred ninety-four participants took the test in its entirety. Using Slovin's formula, the sample size (number of responders) was determined.

$$n = N / (1 + 0.5\,^{2}N) \qquad (1)$$

Where the sample size is n, N is the population size, with a 95% confidence level and the assumption that about 50% of the population will be trustworthy research participants. The stratified-proportional random sample method was utilized to guarantee representation from all 18 BT.

To analyze the survey data that was gathered, SPSS was employed. Each sort of respondent's proportion was calculated. The results were rated on a scale of 1.00-1.49 (Strongly Disagree), 1.50-2.49 (Disagree), 2.50-3.49 (Agree), and 3.50-4.00 (Strongly Agree). The indices of ET's economic, environmental, and social effects were just fair. Male and female respondents' replies were compared using an independent samples t-test. Responses from respondents who were separated into groups depending on their age and educational background were examined using a one-way ANOVA.

## 3. Results

The number of responders and corresponding % for each profile group are in Table 1. These results show that most respondents are male, young (between the ages of 18 and 39), and high school graduates. A college degree might be more prevalent in LO, given that a small extension campus of a public university offers a small selection of academic courses, primarily in agriculture. People had to travel to Batangas City's colleges and institutions to pursue additional degree programs.

The respondents' evaluation of the economic impact of ET in L is shown in Table 2. The most excellent average was that Lobo Ecotourism (LET) increases the income of drivers and operators of transportation services. In contrast, the lowest average was opening gift stores and providing livelihood initiatives supported by donations from tourists. Residents of LO expressed excellent agreement with all claims or economic facts made to them, which was shown by their employing higher than 3.50, with the highest being that Lobo ET creates more income for these people. The findings show that the residents of Lobo accept ecotourism development (ETD) due to the possibility of economic benefit. They view ET as a way to promote their small-town community and improve the standard of living for the locals.

The respondents' opinions on the environmental impact of ET in L are shown in Table 3. Residents of LO also established a firm agreement with the environmental indicators, as demonstrated by a mean higher than 3.50. The most excellent mean rating was given to the circumstances under which LET uses biodiversity as an attraction, whereas ecosystem preservation and the conservation of endangered species earned lower averages. According to the findings, ET is also being embraced by

the people of LO to preserve their natural riches and maintain their environment. Due to its abundant biodiversity, L requires its population to be aware of and protective of the domain.

The respondents' opinions on the social impact of ET in LO are shown in Table 4. A mean of greater than 3.50 indicates that the people of LO highly agreed with all of the indicators offered to them to evaluate LET in terms of the social component. They received the most excellent mean rating for promoting the sustainability of ET destinations via resident engagement in programs and the lowest mean rating for community participation in planning and decision-making.

According to the findings of the community evaluation, ET in LO is also very obviously accepted on a social level. Residents of the community were not antagonistic to ET development since they were engaged and saw the potential social advantages that came along with the economic ones.

**Table 1** Respondents per Category, Number.

| Profile | Frequency | Percent |
|---|---|---|
| Sex | | |
| Male (M) | 206 | 52.3 |
| Female (F) | 188 | 47.7 |
| Age | | |
| 18-29 yrs old | 184 | 46.7 |
| 30-39 yrs old | 100 | 25.4 |
| 40-49 yrs old | 68 | 17.3 |
| 50-59 yrs old | 29 | 7.4 |
| 60 yrs old and above | 13 | 3.3 |
| Educational Attainment (EA) | | |
| College(c) | 127 | 32.2 |
| Masters(M) | 6 | 1.5 |
| Elementary(E) | 27 | 6.9 |
| High School (HS) | 205 | 52.0 |
| Technical –Vocational (Tech-Voc) | 29 | 7.4 |
| Total | 394 | 100.0 |

**Table 2** Economic Aspect of LET.

| Indicators | Mean |
|---|---|
| Develops initiatives for sustaining livelihoods using donations from tourists | 3.55 |
| Encourages the opening of gift shops | 3.54 |
| With the influx of tourists, it increases the income for drivers and operators of transportation services | 3.68 |
| Promotes to tourists a new lineup of goods and services | 3.64 |
| Improves the local economy by giving visitors housing or other accommodations | 3.62 |
| Provides opportunities for funding initiatives that can aid in the region's economic development. | 3.61 |
| Creates more adaptable work circumstances by starting small firms that could benefit the locals | 3.61 |
| Provides jobs for locals in industries like travel guidance and lodging | 3.58 |
| Generates more taxes for the municipality | 3.57 |
| Creates business opportunities within the municipality | 3.62 |

With an overall mean of 3.64, the respondents' comprehensive evaluation of LET is shown in Table 3. LO inhabitants strongly agreed with all of the ET-related topics provided to them for assessment. This demonstrates that the most significant community support for ET growth in LO. Ecotourism Sustainability (ETS) may be realized if this trend persists in the future.

Figure 2 displays the variations in the respondents' evaluations when grouped by Sex. A p-value higher than 0.05 indicates no differences between male and female opinions on any element of LET at the.05 level of significance. In other words, judgments made by men and women are similar, with the difference that males prioritize social and economic concerns more than women on environmental ones. The research does not support the null hypothesis, which states no discernible difference in respondents' evaluations when grouped by Sex. However, it is encouraging that both genders responded similarly and positively assessed the ET increase in LO. Of course, for ET to be viable, it must consider both sexes' specific needs.

**Table 3** LET Connection to the Environment.

| Indicators | Mean |
|---|---|
| Maintains the ecosystem | 3.62 |
| Maintains and preserves the natural resources via adopting standard norms and regulations such as restriction of fishing in protected areas, littering, sand quarrying, and coral reef damage | 3.69 |
| Ensure that Lobo's natural resources, like as its beaches and coral reefs, are not in danger | 3.69 |
| Implements plans or initiatives for the municipality's citizens and visitors' effective trash management | 3.70 |
| Delivers visitors a pleasant, peaceful, or energizing holiday experience without endangering the environment | 3.70 |
| Promotes the preservation of nature more broadly and contributes to the conservation of the environment | 3.68 |
| It uses its flora, animals, and biodiversity in general to attract tourists | 3.77 |
| Contributes to the local community's efforts to safeguard endangered animals | 3.64 |
| Provides environmental initiatives, including tree-planting campaigns and cleanup initiatives | 3.69 |
| Encourages locals to adopt environmentally friendly products, such as paper bags, in place of plastic | 3.69 |

**Table 4** LET's Social Aspect.

| Indicators | Mean |
|---|---|
| Include the neighborhood in the planning and decision-making process | 3.52 |
| It enhances people's feelings of pride and ownership | 3.70 |
| Supports local culture, cuisine, and recreational options to create healthier communities | 3.63 |
| Promotes consideration for both visitors and locals | 3.62 |
| Creates a pleasant environment for guests | 3.69 |
| Increases locals' and visitors' awareness of the region's cultural, socioeconomic, and environmental challenges | 3.61 |
| Composite (C) | 3.64 |
| Promotes local experiences by educating people about sports, including fishing, hiking, diving, and snorkeling | 3.60 |
| Encourages local experiences by teaching about the geographical characteristics of the area and the people that live there. | 3.61 |
| promotes the sustainability of tourist destinations in the municipality by involving locals in initiatives like the creation of artificial coral reefs and the bantay-dagat (deputized coast guard) | 3.74 |
| It provides locals with the chance to meet with individuals from all cultural backgrounds | 3.62 |

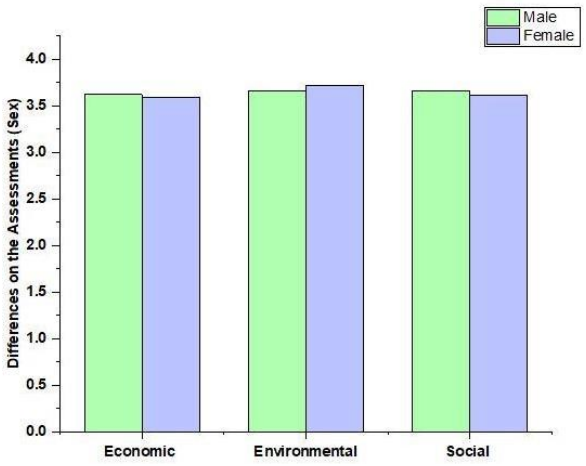


**Figure 2** Differences in the Assessments when Grouped according to Sex.

When the respondents' ratings are classified by age, the variances are shown in Figure 3. The p-value of.014 indicates that there is a significant difference in the ratings of the economic component at the 0.05 level of significance when the respondents are grouped according to age. Each age group's mean ratings showed that those over 50 had higher mean ratings than people under 50. In this case, it refuted the hypothesis that there is no noticeable difference in the respondents' views on the economic aspect of ET in LO when grouped by age.

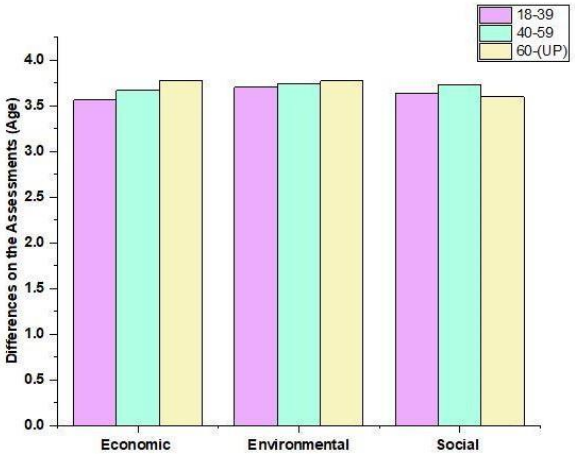


**Figure 3** Age-based groups show different results on the assessments.

Given that those under 50 are more likely to quit LO and look for better career opportunities elsewhere, it becomes reasonable that they would have fewer positive assessments of ET's financial characteristics. The likelihood that someone over 50 would live through their days in LO and be happy with the work opportunities there, including any potential employment benefits ET may offer, is higher. Because they are also at the perfect age to be more active in entrepreneurial endeavors, younger people are beginning to worry that they may also tremendously profit from ET in the long term. ET developers should address these concerns.

The evaluation of the environmental and social aspects and the overall assessment stay the same noticeably when the respondents are divided according to age on the extra dispense. This contradicts the claim that categorizing evaluations of environmental and social factors by age reveal no discernible differences. Environmental and social concerns have received positive feedback from all age groups, which encourages the development of ET in LO since it should meet the demands of the locals who are young, middle-aged, and old.

Figure 4 displays the variations in the respondents' evaluations when sorted by educational level. There is no noticeable difference in the respondents' assessments of any component of ET in LO when categorized according to educational attainment at the.05 level of significance since all of the p-values are greater than.05, supporting the null hypothesis. The natives were aware that they had equal prospects for growth and were required to contribute equally to ET's sustainability regardless of their level of education. People with just an elementary education or little to no formal education will make up the LET.

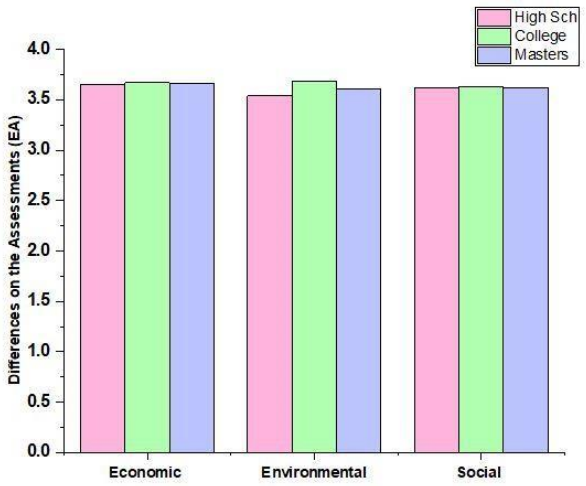


**Figure 4** Assessment Differences Depending on Educational Attainment Grouping.

## 4. Conclusions

The research's results, which are based on the opinions of 18 local communities (BA) in Lo, convey the impression that there is no issue with the growth of ecotourism in Lo, BT, and Philippines (P). If this occurrence persisted for many years, ET in the region would ultimately become viable. It would provide visitors with satisfying and good experiences and more tremendous advantages for the residents and municipal government. The community and the government can supply the facilities and services most visitors will need if ET in LO remains commercially successful. The ET resource base will be preserved, and tourism will go on if the environment and natural resources of the LO can be safeguarded and conserved. In this instance, conclusions can only be formed if the respondents' information is reliable. The use of cross-sectional rather than longitudinal data, a limited number of variables and indicators for assessing those variables, and even the data collecting tool are all limitations.

### Ethical considerations

Not applicable.

### Declaration of interest

The authors declare no conflicts of interest.

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Understanding the influence of parental involvement on science learning task completion

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**Abstract** The parent's involvement is believed to have a big impact on the achievement of their children at home and in school. The major data-gathering technique for the present research, a survey questionnaire, was used to research the impact of parent involvement on students' completion of science learning assignments. The information acquired from the 204 parents of Grade 11 students participating in the academic track at Narra National High School in Narra Philippines and Palawan were analyzed using a mixed-method technique. According to the study's results, most of the parents are working, responsible, full-time students, and competent in terms of their parenting styles, occupations, and levels of education. Parental participation is highly extensive, and the majority of students can successfully average five science learning assignments. The outcome also shows that parental participation levels are independent of both the parents' profiles and the number of learning activities that pupils have completed on those profiles. However, the amount of parental participation affects how many learning activities kids achieve.

**Keywords:** science learning tasks, parental involvement, mixed technique

## 1. Introduction

Parenthood is a challenging endeavor. It demands everlasting love, patience devotion and to becoming a successful one (Shipton and Guirguis 2019). Among their duties as parents, parents have the duty of guiding their children. The responsibility to educate children and provide them with socialization opportunities falls equally on parents and the school. It's general knowledge that the development of children and their achievement is very significant to parents (Gunderson et al 2018). Involvement of parents in the conventional method of instruction delivery that has been standardized by the Education Department is required since COVID-19 has caused significant changes to the teaching-learning process (Flack et al 2020). Face-to-face instruction is almost entirely replaced by online instruction, making parents and other adult guardians crucial to provide their kids with a high-quality education (Lewis et al 2017; Andrabi et al 2017). As they make substantial efforts to provide their children with education, parents are increasingly leading the charge in education (Alam 2021). As schools and their students adapt to the new teaching and learning structure, parents are increasingly assisting them in a variety of ways. Currently, parents must accompany their children to school to get and turn in their children's modules and other learning outputs as part of the Modular Distance Learning modality (Mesci and Schwartz 2017).

Many middle school students think that science and technology are difficult disciplines. Researchers that study science education have stated that pupils still struggle to understand scientific ideas (Boonk et al 2018). When doing scientific experiments and procedures, students sometimes contact their parents. Parents should be aware of the specific lessons to teach their children as a result of this situation since it demands a lot of time and attention.

Jeynes (2018) aimed to examine any connections between parental involvement in their children's educational activities and their degree of academic performance. Park et al (2017) presented a highly practical strategy that may serve as a guide for school leaders and managers in boosting parental participation and engagement in their respective schools. The Dual Navigation Approach (DNA) model is the name given to this concept. So et al (2022) explored whether three types of PI at the school level for the betterment of education for all students, PI for the benefit of individual students, and PI to build social networks among parents (networking) relate to student achievement at the school-level and the learning environment at the school. Antony-Newman (2019) proposed that because parents' choice to send their children to HBL was not voluntary but rather the result of an outside force, HBL's mechanism during the COVID-19 pandemic necessitates new understandings. Li and Fischer (2017) offered a methodical synthesis of 40 qualitative and quantitative studies on immigrant parents' parental participation in Australia, Asia, Europe, and North America. Fernandez (Alonso et al 2017) investigated the connection that exists between family networks and parental participation in their children's primary schools during those crucial formative

years. (Gilbert et al 2017) investigated the connection that can be drawn between the many ways in which parents are involved in their children's lives at home and the levels of academic success those children experience.

**Study Questions**

The goal of this study was to determine how parental participation affected how well pupils learned science material. It addressed the following issues in particular:

1. How would you characterize the parents' profile:
   - working situation;
   - Education level, as well as parenting style?
2. How much are the respondents' parents involved with them?
3. How many learning assignments do students accomplish on average each week?
4. Is there a strong connection between the parents' characteristics and their degree of participation as parents?
5. Is there a strong connection between a parent's profile and the number of tasks youngsters do for learning?
6. Does the amount of parental participation significantly affect the number of learning activities that kids complete?
7. How does parental engagement affect kids' ability to complete science learning tasks?

## 2. Materials and Methods

A mixed technique was used in this investigation. Data were gathered mostly via a questionnaire. The quantitative portion centered on determining the impact of parental participation on child's completion of science learning activities as well as the link among the profile of the parents, the quantity of the amount of parental involvement, and successfully performed educational assignments. For the qualitative portion of this research, however, "Focused Group Discussion (FGD) was employed to confirm the information offered in the structured interview".

### *2.1. Respondents*

Parents of Grade 11 students from the four academic strands Humanities and Social Sciences (HUMMS), Accounting, Business and Management (ABM), Science, Technology, Engineering, and Mathematics (STEM), and General Academic Strand (GAS) Participants were requested to take part in the research. There were a total of 204 respondents in total. They were chosen with a 0.05 margin of error using Slovin's Formula. Since this research aims to ascertain the participation of parents in its impact on students' completion of learning activities in Science, probability sampling was specifically employed in combination with simple random sampling. To ensure that every potential responder had the sample size using the fishbowl method, this gives each participant an equal chance of being selected.

### *2.2. Data tools and procedures*

Before the Focused Group Discussion (FGD) and the distribution of the questionnaire, the respondents' permission was requested. Respondents received guarantees that the data they would supply would be treated with the greatest secrecy. When the school's parents received their modules, the questionnaire was administered at the same time. They were informed that the questionnaire will have two (2) components to it. The first section collected data on the profiles of the parents, including their job situation, level of education, and parenting philosophy. The second section of the questionnaire, which examined parental involvement levels, included fifteen items on a 5-point Likert scale with interpretations ranging from 1 to 5, with a score of 1–1.99 denoting "not involved," 2–2.99 denoting "less involved," 3–3.99 denoting "somewhat involved," 4–4.99 denoting "very involved," and 5.00 denoting highly involved. Before the questionnaire was given to the respondents, it was administered to thirty parents of Grade 11 students who were not a part of the research sample to confirm its validity. The questionnaire's dependability was investigated using Cronbach's reliability analysis. The Test's Dependability and Validity were shown in this research by Cronbach's alpha, which was 0.72. To collect information for the study's qualitative component, a structured interview was conducted. Following the respondents' replies, the researchers recorded and transcript them. Standard procedures and health guidelines were followed during the execution of this investigation.

### *2.3. Data Analysis*

The Statistical package for social science was used to analyze quantitative data. The profile of the respondents and the several learning activities completed by the students every week were described using frequency counts and percentages. We calculated the level of parental participation using the weighted mean. The association between the number of learning activities performed and the level of parental engagement was established using linear regression analysis, and the relationship between the parent's profile and other factors was established using multiple regressions. On the other side, qualitative data were gathered and examined to identify themes based on each respondent's comments. To produce the data required for the research, Braun and Clarke's thematic analysis was employed. It then proceeded to familiarize itself

Create preliminary codes from the data, explore themes, investigate topics, identify themes, and create the report.

## 3. Results and discussion

The parents' job situation, level of education, and parenting style are all detailed in Table 1. As shown, 78 people, or 35%, had full-time jobs, while 21 people, or 10%, were jobless. 67 of the parents, or 32%, had completed their undergraduate degrees, while just two, or 1%, had completed their master's degrees. 117 respondents, or 59%, described their parenting style as authoritarian, while just 1% indicated they were uninvolved.

**Table 1** Parental demographics include occupation, education, and parenting philosophy.

| | Frequency | Percentage |
|---|---|---|
| Employment Status | | |
| Unemployed | 21 | 10% |
| Part-time | 35 | 250% |
| Full-time | 81 | 35% |
| Self-employed | 71 | 35% |
| Total | 209 | 100% |
| Educational Attainment | | |
| College Undergraduate | 55 | 35% |
| College Graduate | 67 | 32% |
| High school undergraduate | 11 | 5 |
| High school Graduate | 53 | 22% |
| Elementary graduate | 15 | 9 |
| Did not finish M.A. | 9 | 5% |
| Total | 291 | 110% |
| Parenting Style | | |
| Permissive/Indulgent | 48 | 27 |
| Authoritative | 117 | 59% |
| Neglectful/Uninvolved | 2 | 1% |
| Authoritarian/Disciplinarian | 45 | 23% |
| Total | 212 | 100% |

### *3.1. An Extent of Parental Involvement*

The level of parental participation is seen in Table 2. The composite mean of 4.21 indicates that they were Very Involved in completing their children's learning activities across all of the variables.

**Table 2** Parents' Involvement Levels.

| Parental involvement | Interpretation | Weighted |
|---|---|---|
| Follow the development of my child's science learning assignments. | Very Involved | 4.21 |
| For my child's science requirements and projects, please provide the essentials (devices, required texts, and other school supplies). | Very Involved | 5.58 |
| My children will have access to the internet for educational reasons. | Very Involved | 5.24 |
| Discuss my child's future goals and the benefits of a solid education. | Very Involved | 5.41 |
| I want to encourage my kid to read scientific books and other resources at home. | Very Involved | 2.10 |
| A PTA or homeroom meeting should be attended. | Very Involved | 4.15 |
| Help my child with his/her science homework. | Very Involved | 4.04 |
| Before submitting the learning exercises, I went through and double-checked my child's responses. | Very Involved | 4.49 |
| Spend time visiting the school when the instructor requests it and be willing to complete any assignments given by the institution. | Very Involved | 4.11 |
| Reward or encourage my child for putting out a decent effort and finishing the learning activities. | Very Involved | 4.51 |
| Help my child identify what is challenging and what is simple in terms of complexity | Very Involved | 4.29 |
| Encourage my child to communicate about their emotions and academic struggles. | Very Involved | 4.21 |
| Ask the instructors for updates on my child's growth on a regular basis. | Very Involved | 4.11 |
| Set a consistent time and place for my child to do his or her homework at home. | Very Involved | 4.15 |
| Average Composite | Very Involved | 4.21 |

### *3.1. The Number of Learning Tasks Completed*

The average number of learning activities that each student completed is shown in Table 3. 5 out of 114, or 57%, of them can successfully complete 5 science learning assignments on average.

**Table 3** Total of completed educational activities.

| Number of Learning Tasks Completed | Frequency | Percentage |
|---|---|---|
| 1 | 1 | 1% |
| 2 | 5 | 3% |
| 3 | 7 | 4% |
| 4 | 32 | 14% |
| 5 | 114 | 57% |
| 6 | 45 | 21% |
| 7 | 8 | 4% |
| Total | 212 | 104% |

### *3.2. Correlation between Parental Characteristics and Involvement Levels*

The association between the parents' profile and the number of involvement in their child's learning is shown in Table 4 to some extent. The p-values of 0.07, 0.67, and 0.85 were all higher than 0.05, thus we could not rule out the possibility that there is no correlation between the parents' characteristics and their level of engagement. So, it can be claimed that the profile of the parents has no bearing on the extent of parental involvement. Figure 1 and 2 shows the standard error and P value of Correlation between Parental Characteristics and Involvement Levels respectively.

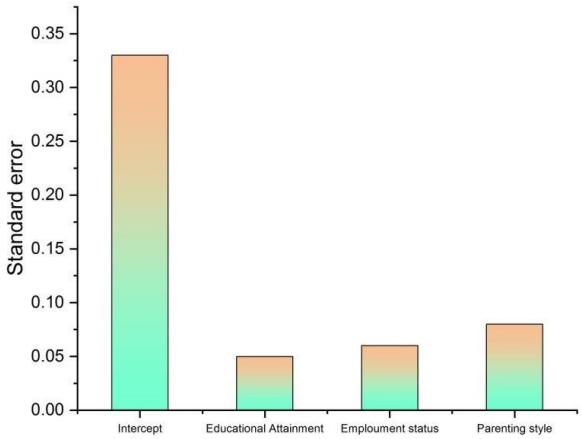


**Figure 1** The standard error of Correlation between Parental Characteristics and Involvement Levels.

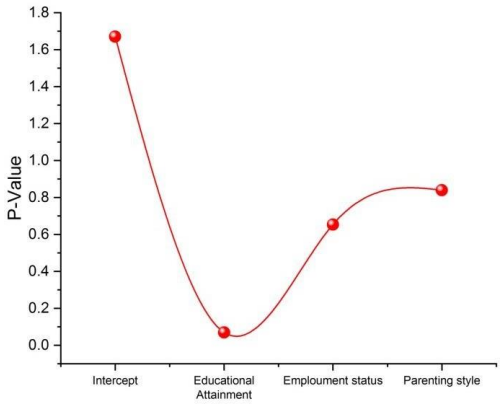


**Figure 2** The P-Value of Correlation between Parental Characteristics and Involvement Levels.

**Table 4** Parental involvement is significantly related to parent demographics.

| | upper | stderr | p-value | tstat | lower | coeff | vif |
|---|---|---|---|---|---|---|---|
| educational attainment | 0.122195 | 0.035 56338 | 0.075 7402 | 1.814 6244 | -0.00 445 | 0.058 55304 | 1.22 8781 |
| Intercept | 4.315723 | 0.181 61254 | 1.672 E-51 | 20.00 65 | 2.571 774 | 3.940 74195 | |
| parenting style | 0.105 2514 | 0.041 80371 | 0.855 4155 | 0.205 5143 | -0.04 812 | 0.101 03512 | 1.02 8065 |
| Employment Status | -0.04 263 | 0.032 21791 | 0.205 5140 | -0.43 8452 | 0.811 3591 | -0.02 71705 | 1.02 8163 |

*3.3. Parents' profiles and the number of learned tasks completed have a relationship with each other.*

The parent profile and the pupils' successfully completed learning activities are significantly correlated, as shown in Table 5. The p-values were 4.51, 0.46, and 0.72, all of which were above 0.05 hence the statement "fail to reject the null hypothesis" was prepared. This suggests that here is little or no relationship among the parents' characteristics as well as how well their children accomplish their academic work. It follows that the amount of learning activities that kids have done is independent of the profile of their parents. Figure 3 shows the number of learned tasks and the standard error of the parents' profiles, while Figure 4 shows the same information for the parents' profiles and the corresponding P-value.

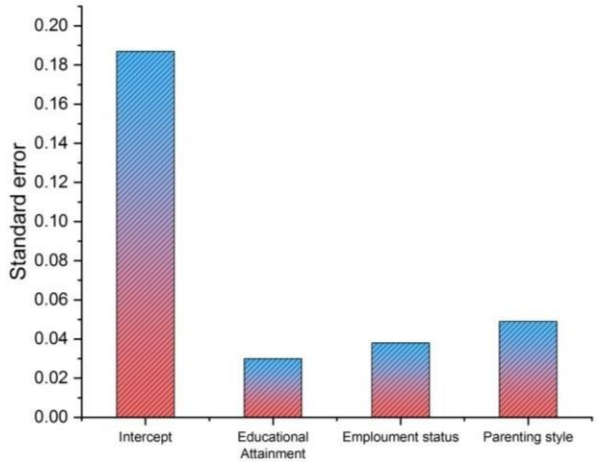


**Figure 3** The number of learned tasks and the standard error of the parents' profiles.

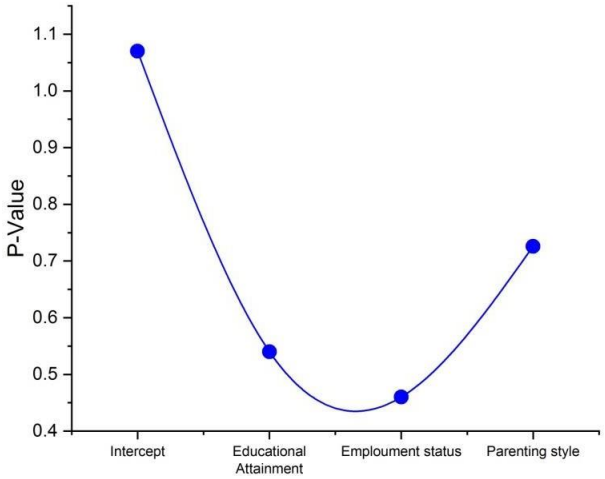


**Figure 4** The number of learned tasks and the P-value of the parents' profiles.

**Table 5** Parental involvement is significantly related to parent demographics.

| | lower | coeff | vif | tstat | upper | p-value | stderr |
|---|---|---|---|---|---|---|---|
| educational attainment | 0.152 541 | 2.512 581 | 1.31 7581 | 5.71 4561 | 0.354 642 | 4.52 E-05 | 0.01 3574 |
| Intercept | 4.215 065 | 2.562 961 | | 10.6 E-21 | | 2.93 274 | 0.31 0181 |
| parenting style | -0.13 220 | 0.031 672 | 1.05 8165 | 0.31 9551 | 0.205 542 | 0.721 741 | 0.05 7654 |
| Employment Status | -0.15 215 | -0.02 984 | 1.35 8132 | -0.5 4001 | 0.091 022 | 0.451 122 | 0.04 7295 |

## 4. Discussion

According to Table 6, there is a substantial correlation between parental participation and the quantity of learning activities that kids successfully complete. Since there is insufficient information to establish that the degree of parental participation is connected to how well the kids complete their learning activities, since the p-value of 0.04 is less than 0.05,

we conclude that the null hypothesis must be rejected. Hence, it may be claimed that the amount of parental participation affects how many learning activities kids accomplish.

Parents' support and participation in their children's education are essential in the Philippines' present learning model, as is seen from the parents' coded replies. Parents' love and devotion may have an impact on their kids' academic performance. When kids do well or get good marks in their classes, parents congratulate them. For them, they are how parents might encourage their kids to complete each learning assignment in the program. Parents often push their offspring to do all homework and class work. The vast majority of parents who participated in the survey said that their guidance is essential since their children are more likely to follow instructions and complete assignments when they are there. If parents check in on their kids' homework progress, it may motivate them to finish and hand in their assignments on time. Parents also said that they must constantly set aside time to watch the performance of their kids to see how effectively she completes their tasks or discover the obstacles she experiences so that they may assist her in resolving such issues. More importantly, parents' complete support is crucial for encouraging their children to study and perform better. Parents who responded also mentioned giving their kids access to the internet, technology, and money to help with their schooling. Parents believe that moral support and encouragement are additional forms of help. Parents may assist pupils by clarifying complex concepts they do not understand. It was easier to complete the learning activities at home when parents shared their knowledge and abilities with their children. Parents claim that other factors that might affect their child's success include engaging in parent-teacher conferences, receiving calls from the instructors, and reading communications from the school. They may use them to monitor their child's academic development and the status of Science learning assignments that have been accomplished.

**Table 6** Significant correlation between the number of learned activities performed and parental involvement.

| | lower | tstat | upper | p-value | stderr | coeff |
|---|---|---|---|---|---|---|
| Number of Learning Tasks Completed | 0.158544 | 5.714561 | 0.354642 | 4.52E-02 | 0.043544 | 2.412551 |
| Intercept | 4.215066 | 10.1E-21 | 2.451812 | 2.93274 | 0.315181 | 2.562961 |

## 5. Conclusions

The results of the research confirm that parents are significantly active in completing their children's science learning activities, which is evidence that the level of parental participation in kids' learning affects the students' performance. Students may finish an average of five Science learning assignments when parents are participating. Therefore, the level of parental participation affects how well students do their science homework. The level of parental participation, however, is independent of the parents' profiles. The level of parental participation in their child's education or fulfillment of school obligations was not necessarily impacted by the parents' backgrounds. Therefore, this research suggests that parents must play a significant role in their children's education. Therefore, whether there is a pandemic or not, the school should start awareness programs to increase parental support for kids' education. Since this study only included students from the Academic Track, further research is needed to discover the obstacles faced by students from other tracks or grade levels while completing learning activities; this information might then be used as the basis for policy creation.

## Ethical considerations

Not applicable.

## Declaration of interest

The authors declare no conflicts of interest.

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Effect of Facebook news use on political attitudes and participation

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**Abstract** Politics may be significantly impacted by how often people access Facebook news. Users' understanding and comprehension of political topics may improve as a result of being exposed to political headlines on Facebook, which may have an impact on how they feel and what they believe. Facebook users may be more inclined to have passionate opinions on political topics and engage in political activism if they often read political news on the social media platform. In this study, we examined the effects of Facebook network size, connections with public political actors, use for news, and political expression on political attitudes, protest, and participation. We did this by considering the Orientation Stimulus Reasoning Orientation Response (OSROR) framework for political engagement impacts into consideration. According to data from Hong Kong's (HK) whole population, a city that has one of the highest rates of Facebook adoption globally, structural equation analyses were carried out. Results indicated considering Facebook's size and connections to influential political leaders had an impact on users' engagement in Facebook news, expression, and effectiveness in both direct and indirect ways. Through political speech, Facebook news largely had indirect consequences. A discriminant function analysis also revealed that the most important factors for separating Facebook users from nonusers were age, education, and exposure to online news. This research has consequences for political campaigns and groups trying to enlist members on social media sites like Facebook.

**Keywords:** Facebook, politics, participation, Facebook network size, OSROR

## 1. Introduction

Over the course of the last decade and a half, advances in information and communication technology have had a huge impact on the whole planet. For instance, the use of new media and technology has changed the social and political conversation, communication techniques, and interpersonal connections. Researchers from political science, sociology, communication and media, and international relations have examined various aspects of social media usage (Golan et al 2019). The Internet has made it possible for the general people to learn a great deal about political events, and it also engages and inspires its users to take part in political activities offline. Participation in politics has become more dependent on the Internet. The advent of social media and the internet has fundamentally changed how sophisticated countries communicate politically.

In addition to being accessible 24/7 on an ever-growing number of channels with constant deadlines, the news is now being disseminated and consumed via digital networks through so-called intermediates, such as social networking sites like Facebook (Ahmad et al 2019). Over 2 billion people use Facebook, making it one of the most widely used Internet applications in the last ten years. College students are using it more and more in both their social and academic lives, which is unprecedented. 70 to 90 Facebook users are college students or adults in their first or second year. Users may update their status, update their wall, remark, read their news feed, like, message, upload a picture, organize a group, play games, manage fan pages, create events, take notes, and communicate in groups on Facebook, among other functions (Karlsen and Aalberg 2023). For young individuals to retain their online identities and grow their social networks, Facebook has become an essential tool. The demands for social interaction and the procedure of unorganized information on Facebook, however, can have a detrimental impact on how well pupils learn. In other words, there is a change in how individuals read the news. More and more individuals, especially the young, rely on social media, most often Facebook, to read their daily news (Sterrett et al 2019). We are just starting to comprehend how these middlemen impact how people perceive the news and the veracity of headlines, and these shifts may have real repercussions on viewers of news and the function of news organizations in democratic nations.

Politics-related news is a crucial component of the information shared on Facebook (Feng et al 2019). Consequently, 66% of Facebook users access news on the platform, making the Social Networking Site (SNS) a crucial conduit for news

about current events. Users of SNSs have a wider variety of friends than offline connections, which include both strong and weak links. Recent research reveals that most friend lists are rather broad and that there is more dispute among buddies than predicted, despite worries that algorithms and the propensity to be friends with others who have the same interests restrict the variety of information that is displayed (Levy 2021). The circumstances of society are diverse in a nation that upholds a democratic government. Political involvement is one of the distinctive features of a democratic society. Political involvement is the action of an individual or group of people to actively engage in political life, including, but not limited to, either directly or indirectly choosing a state leader and influencing governmental policies. Public or citizens engagement in general elections is one kind of political participation. The election is the people's wish or will to bring about a change for the greater good via the selection of regional leaders, the President, and representatives for the people (Maulana 2022).

Rossini et al (2021) presented dysfunctional information sharing on Facebook and WhatsApp, focusing on two explanatory variables: the frequency of political discussion and cross-cutting visibility and possible solutions, including observing, witnessing, and enacting social corrections. The findings imply that dysfunctional communication is widespread; about a quarter of respondents reported spreading misleading data on Facebook and WhatsApp, but social adjustments also happen often. Bail et al (2020) combined nonpublic Twitter data concerning the Russian Internet Research Agency (IRA) with longitudinal information from late 2017 that characterized the opinions and online habits of 1,239 Republican and Democratic Twitter users. They do not find any evidence, using Bayesian regression tree models, that contact with IRA assets during a 1-mo period significantly affected any of the six numerous metrics of political beliefs and behaviors. In the early weeks of the national healthcare crisis, Gadarian et al (2021) looked at the health practices, beliefs, and policy perspectives of the American people on COVID-19. Between March 20 and 23, 2020, they created and administered an original comprehensive survey to 3,000 American citizens to gather information on 38 health-related actions, preferred governmental responses to COVID-19, and pandemic concerns. Lutzke et al (2019) evaluated how two straightforward interventions, each engaging in thinking critically, affected people's assessments of the veracity of true and false weather news on Facebook. Through a web-based test, participants (n = 2,750) were given the option of reading a set of recommendations for assessing online news or reading the instructions and rating their value; a control group did not receive any guidance.

Ecker and Ang (2019) evaluated individuals who identified with left- and right-wing political groups using hypothetical situations depicting political misbehavior by respective organizations' leaders. The Continuous Influence Effect (CIE), which occurs when false information persists in people's memories and inferences after it has been corrected, is a common occurrence. The citizen-centric acceptability model was presented by Alarabiat et al (2021), and it was validated. By including new elements discovered in pertinent literature, the suggested model expands the model that was first developed on the notion of deliberate conduct. 400 Facebook users in Jordan were surveyed, and the results were obtained using a random sample method. The suggested method or possible reinforcing of certain views and how it may influence people's political conduct, particularly in non-electoral contexts. Ohme (2021) examined the impacts of social media use on attitudes reinforcing while focusing on deportation following the refugee flow into Europe in the fall of 2015. It links this to political involvement in refugee-related events. The association between populist sentiments, devotion to democracy, and political involvement was explored by Zaslove et al (2021). The paper uses data from the Netherlands to demonstrate that people with greater support for populism are more in favor of democracy, are not as inclined to demonstrate, are more in favor of elections, and are more in favor of thoughtful involvement methods in politics.

## 2. Materials and Methods

In this section, we present the Orientation Stimulus Reasoning Orientation Response (OSROR) paradigm. The initial O symbolizes a state of mind that exerts control over which stimuli are seen as important and which ones are not in their original definition in social psychology. These are often the variables that affect the amount and kind of media attention in media studies. For instance, research has shown a connection between post materialist beliefs and earlier media-use goals and greater media exposure, which may result in higher levels of political expression, information, and engagement. The S can be represented by media exposure parameters using the OSROR design. The function and ability of the news to foster a politically engaged citizenry have long been a primary concern amongst political engagement experts due to keeping the public informed about political and current affairs is the news media's fundamental responsibility. R has been added to the fundamental OSROR structure considering all of the cognitive operations that relate the effects of stimulus (S) on later cognition results. These involve the efforts made in mind to "elaborate" and "reflect" on information that has been received, which is expressed via political discourse. The second O stands for cognitive outcome communicative orientations, crucial preconditions for political involvement. Political efficacy is one of the most significant precursors since it has been a key predictor of democratic involvement. This is because people's beliefs in their capacity to engage in and affect politics have been a primary prediction. Planned or actual conduct makes up the model's last element. Political involvement is the most important metric in political interaction studies since normative models of democracy assume that citizens are actively participating in the democratic process. It's crucial to take into account protesting as a different behavior in the setting of HK. The theoretical model shown in Figure 1 served as the foundation for the designated pathways.

The design's many elements may all theoretically have an immediate impact on engagement, as seen in Figure 1. For instance, political and news-related Facebook use may lead users down separate roads to political protest and involvement. This is due to the fact that media coverage often offers the background and material needed to support ensuing debates about societal topics like politics, which might as well promote involvement. Considering the massive data, it is predicted that this study on Facebook will have a similar indirect effect and a prediction is put forth:

H1: The usage of Facebook for political discourse will attenuate the effect of Facebook news consumption on political involvement and protest.

The OSROR approach is being tested for the first time in an Asian setting in this research. The generic Research Question (RQ) is therefore posed since it would be wasteful to provide definitive hypotheses for each of the direct and indirect approaches demonstrated in Figure 1:

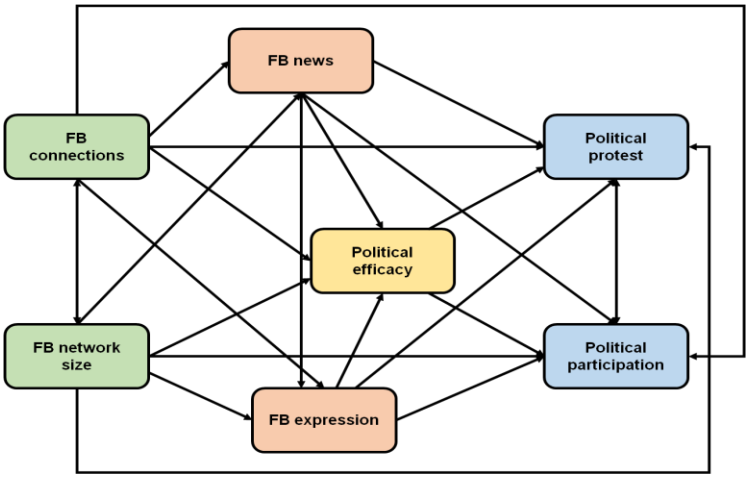


**Figure 1** OSROR paradigm-based conceptual structure.

RQ1: The degree to which Facebook's uses of efficacy (O), news (S), and expressiveness (R) moderate the connection between involvement (R) and network features (O)?

Some preliminary clues may be provided by comparing users with non-users. Consequently, a subsequent RQ is asked:

RQ2: Do Facebook users and non-users in HK have different statistics, political views, media use, and participation?

*2.1. Dataset*

The research institution connected with a university in HK carried out an online poll in July 2014. The rate of home landline adoption in HK was 99.95%, based on the most recent official figures. The most recent HK household telephone directory was used to randomly select phone numbers. The final two digits of unlisted addresses were changed to values between 00 and 99. The desired participant was chosen from each home using the most current birth approach. An overall response rate of 35% was obtained using the reaction rate 1 from the American Association for Public Opinion Research, with a 3.4% rate of mistakes. Participants were all Cantonese-speaking citizens between the ages of 18, and 70.466 those polled, or 57% of the study, use Facebook.

*2.2. Network size of Facebook*

The Facebook network encompasses far more than just individual profiles. It includes a vast ecosystem of people, groups, enterprises, and organizations linked together by a virtual network of social connections. Facebook is a powerful instrument for collaboration, information sharing, and communications on a scale never before seen because of its complex web of relationships. In this investigation of the scale of the Facebook network, we explore the complicated web of relationships that characterizes this universal platform. We look at its astounding user base, the variety of organizations that thrive there, and the wide-ranging effects of its ever-growing influence. We acquire insights into the transformational force of social media in our linked society and the problems with its expansion by comprehending the breadth of the Facebook network. According to those polled, they have the following numbers of Facebook friends: one (1-100), two (101-250), three (251-500), four (501-1000), and five (1,001 or more) (M = 3.12, SD = 2.05).

*2.3. Relationships on Facebook with prominent political figures*

Facebook relationships with prominent political figures have changed the mechanics of political communication, allowing politicians to communicate directly with voters and reach a bigger audience. Politicians can now interact with their people more directly thanks to digital media, which allows them to go beyond conventional bounds. Political actors may

distribute their ideas in actual time and promote a feeling of connectedness and accessibility via official sites, live broadcasts, or participatory postings. However, these links also bring up special issues that must be considered. Due to social media's explosive growth, concerns have been expressed regarding how these platforms may affect political division, the propagation of false information, and the possibility of algorithmic biases. It is vital to analyze the structure of Facebook's relationships with prominent political figures and comprehend the ramifications these connections have for democratic procedures and the shaping of public opinion. When asked whether they had any of the following links on their Facebook page, respondents answered either yes or no. (1) "Friend" or "Like" a political party; (2) "Friend" or "Like" a social or political activist; (3) "Friend" or "Like" a political analyst; and (4) "Friend" or "Like" the district council participant, lawmaker, or another representative of the authorities.

*2.4. News consumption on Facebook*

The capability of Facebook to customize the news feed depending on users' preferences and interests is one of its main benefits for news consumption. Facebook's algorithms create a customized news feed that shows users stuff that is relevant to their interests by examining user behavior, such as the sites they follow, the content they interact with, and their demographic data. By ensuring that people are exposed to the news that appeals most to them, this tailored approach improves user experiences while encouraging empowerment and involvement. In addition, Facebook's significance as a platform for news consumption has been aided by its extensive network of content creators, media outlets, and journalists. The platform is a potent medium for circulating news material, letting publishers connect with a huge and varied audience. Users may receive news items from numerous sources and get a comprehensive grasp of complicated subjects thanks to the democratization of news delivery, which has given birth to a rich tapestry of viewpoints and opinions. The amount of how respondents use Facebook to keep up with politics and current affairs on a normal day was reported as follows (M = 1.32, SD =.75): zero (none), one (15 minutes), two (30 minutes), three (45 minutes), four (60 minutes), and five (plus 60 minutes).

*2.5. Facebook as a platform for online expression*

Facebook's strength as a medium for online expression resides in its capacity to strengthen disadvantaged populations, give voice to the unheard, and foster communication and mutual comprehension. Facebook provides a welcoming atmosphere where people can express themselves, interact with others, and have important discussions, whether it's through expressing personal experiences, giving comments on current events, or showing creative talents. Facebook struggles to create a welcoming and secure atmosphere while facilitating widespread online speech. The platform has taken proactive steps to protect user security and overall health by addressing problems, including erroneous data, hate speech, and issues with privacy. Facebook keeps improving its rules and spending money on technology to deal with these issues, striking a careful balance between encouraging free speech and protecting its community. The participants showed how frequently they express their personal political views and opinions, share others' political opinions and points of view on Facebook, republish data collected from Facebook friends about politics and current events, and read about politics and current events from news outlets outside of Facebook, with responses ranging from 1 (never), 2 (rarely), 3 (sometimes), and 4 (often). An average of the responses was used to create a single scale (M = 2.63, SD =.63, $\alpha$=.78).

*2.6. Efficiency in politics*

The trust that someone has in their capacity to comprehend political processes and contribute meaningfully to them is referred to as their civic efficacy. It includes a feeling of assurance, sway, and involvement in influencing the political environment. It is a crucial idea in democracies since it directly affects people's propensity to take part in political activities like voting, having political conversations, and standing up for what they believe in. It is crucial to remember that a number of variables, including socioeconomic condition, educational attainment, and historical context, may have an impact on political effectiveness. For instance, marginalized groups may experience structural obstacles that undermine their confidence in their own accord political effectiveness. Promoting inclusion and guaranteeing that everyone has equal access to meaningful political participation requires recognizing and resolving these inequities. Replies to the two inquiries that examine internal political effectiveness ranged from 1 (strongly disagree) to 5 (strongly agree). Both were modified, and I believe I possess a solid grasp of HK politics and current events, making me well-qualified to engage in political activity there (M = 2.04, SD =.82; r =.52, p <.001).

*2.7. Participation in politics*

Political engagement may take many different forms, from more conventional ones like voting in contests and joining party affiliations to more modern ones like taking part in internet activism and rallies or demonstrations. It includes both individual and group endeavors, all of which support the vitality and inclusivity of democratic institutions. Political engagement is important because it may give people power and ensure their opinions are heard. It enables citizens to voice their concerns, fight for their rights, and demand accountability from elected leaders. People may influence governmental

policy, encourage social change, and strive toward fulfilling their aspirations for a better society by being involved in politics. If the participant had done any of the following in the previous 12 months, they were asked to indicate it by answering 1 (yes) or 0 (no): (1) signing a statement about a social or political problem; (2) time spent giving to an ideological or social cause; (3) attending an event or gathering for politics; (4) approaching a public representative; (5) making a donation to a charity or social organization; or (6) going to a political gathering. Additionally, participants stated that they voted votes in the 2012 federal legislative election. The total measure of political engagement (M = 2.47, SD = 2.38) was created from the seven components.

Concerning their chance of attending a political rally during the next 12 months, participants gave answers ranging from 1 (extremely unlikely) to 5 (very probable) (M = 3.32, SD = 2.32). We considered the population, interest in politics, and consumption of other news as statistically variable sources. Regulating political interest is essential since prior research has shown that it acts as an influencing factor for political engagement.

## 3. Results

The research variables were all correlated, while partial out variation credited to the controlling factors (political objectives, exposure in the media, and demography) to get the data ready for analysis. The partial relationship matrix was created. Table 1 presents a summary of the generated matrix. The highest probability estimation was used to feed the matrix into the Mplus 7 application for modeling structural equations analysis.

**Table 1** Matric of Partial Connectivity of the Major Study Components.

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Network size | - | | | | | |
| Connections | .44*** | - | | | | |
| News | .44*** | .48*** | - | | | |
| Expression | .37*** | .47*** | .60*** | - | | |
| Efficacy | .35*** | .28*** | .32*** | .32*** | - | |
| Protest | .33*** | .29*** | .29*** | .29*** | .37*** | - |
| Participation | .24*** | .44*** | .33*** | .38*** | .35*** | .29*** |

The research used the multiple fit criteria technique to determine if the data matrix matched the theoretical model. The Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) cutoff values should be at least.95, and the Root Mean Square Error of Approximation (RMSEA) and standardized Root Mean Square Residual (SRMR) scores would be below.06 and.08, correspondingly. However, perhaps two other elements may affect how social media works. First, the impact of social media usage is likely dependent on the user's political allegiance, as with candidate lies. Second, the impact of technological advances may vary depending on the social media platform, given the various capabilities and customs connected with each. Even while Facebook is the most popular service, throughout the 2016 election period, numerous other social media sites, such as Twitter, YouTube, and Reddi, shown in Figure 2, were also utilized to get political news. It is important to note that, in all three waves, p <.001, Facebook users received political news through social networks more often than users of solely other social media sites.

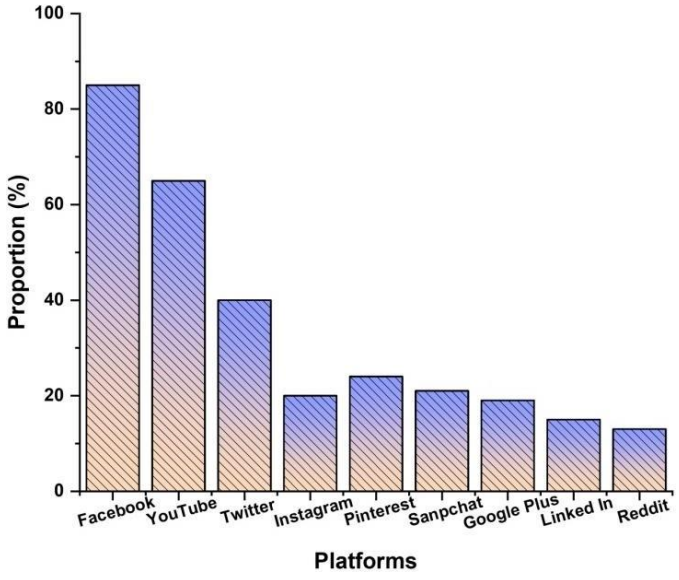


**Figure 2** Platforms for obtaining news.

*3.1. Examination of the Respecified Model and Full Model*

The results showed that the complete model derived from Figure 1 fulfilled the cutoff requirements properly: $\chi^2$ (1) = 1.73, p =.18; CFI = 2.00, TLI =.84, RMSEA =.05, SRMR =.02, even though the TLI and RMSEA values barely made the proposed threshold. The respecified modeling was evaluated by removing any insignificant paths between factors observed in the entire model (p >.05) to see whether the fit could be made better. The respecified model demonstrated a good fit with the following values: $\chi^2$ (5) = 5.17, p =.16; CFI = 2.00, TLI =.88, RMSEA =.03, SRMR =.02, and significant increases in the TLI and RMSEA values shown in Figure 3.

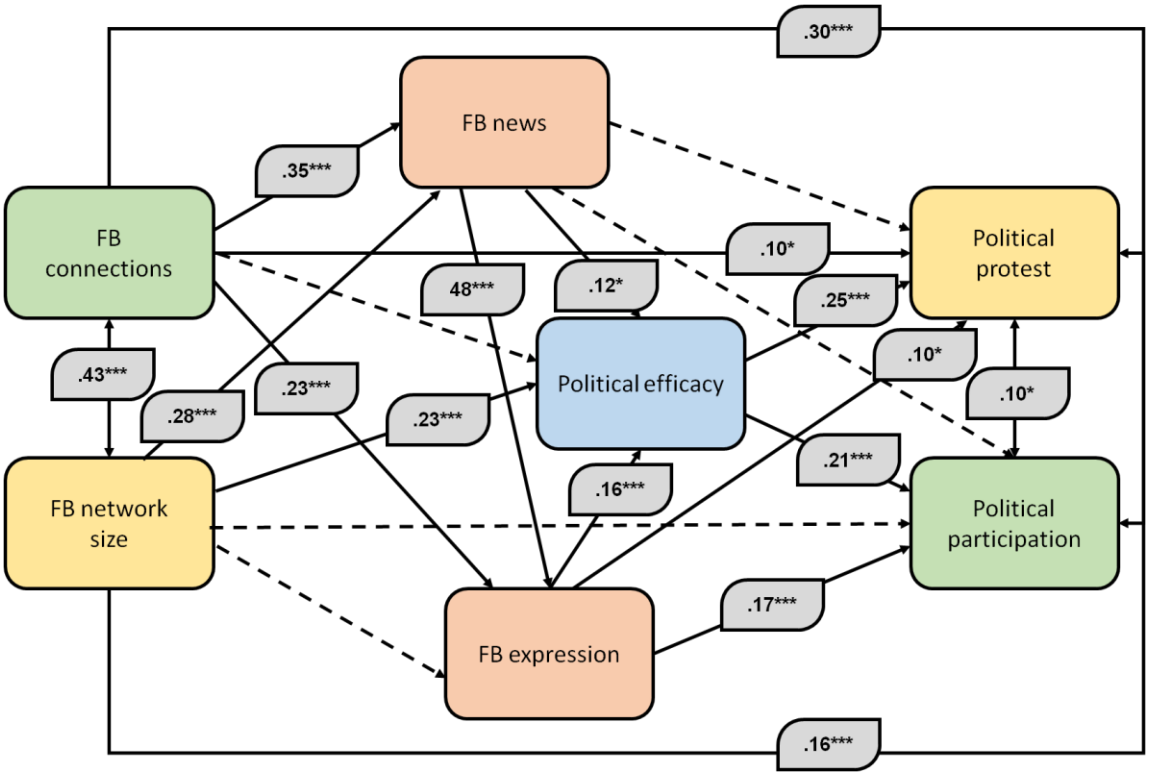


**Figure 3** Final model.

Relationships with public actors ($\beta = .24, p < .001$) and network size ($\beta = .17, p < .001$) were connected to Facebook usage for news and accounted for 28% of the variation, according to an analysis of the immediate consequences along every stage of the model. Relationships to the public sector and news influenced expression, explaining 39% of the variation ($\beta = .12,\ p < .001$) and ($\beta = .37, p < .001$), respectively. Network size($\beta = .12, p < .001$), news($\beta = .21, p <$ $.05$), and expressiveness ($\beta = .25, p < .01$) were related to political effectiveness, and together they accounted for 16% of the variation.

In order to predict political protest, network size($\beta = .15, p < .001$), relationships($\beta = .11, p < .05$), phrase($\beta =$ $.11, p < .05$), and efficacy($\beta = .26, p < .001$), were all taken into account. In contrast, connections($\beta = .26, p < .001$), communication($\beta = .16,\ p < .001$), and effectiveness, which explained 26% of the variation, predicted political engagement($\beta = .21, p < .001$). Results revealed that all factors had direct impacts on political involvement and protest, as shown in Table 2, with the exception of using the use of Facebook for media and the connection between political engagement and the size of networks.

*3.2. Examining the indirect impacts*

The general and specific indirect effects that the factors had on one another are also shown in Table 2. The relative significance of every impact as a percentage of the overall indirect impact may be accounted for by considering certain indirect impacts. The results are in line with other research that used communication mediation models to examine if using Facebook for news could be associated with political activity, protest, and political discourse (H1). They demonstrated that the overwhelming share of all indirect impacts was accounted for by the news (S) expression (R) route. “The routes from the news (S) efficacy (O) and news (S) expression (R) efficacy (O) were both significant”. The results once again demonstrate a wide range of relevant pathways with respect to the degree to which Facebook uses for expression, news, and efficiency would temper the relationship between network characteristics and engagement. In contrast, the specific inadvertent consequences for relationships on different paths roughly equally spread political involvement and protest. The scenario in

question was the gender disparity in political engagement, which is seen in Figure 4. According to research on Facebook political comments, female users between the ages of 20 and 60 were less likely than equivalent male users to participate in political discussions on the social media platform.

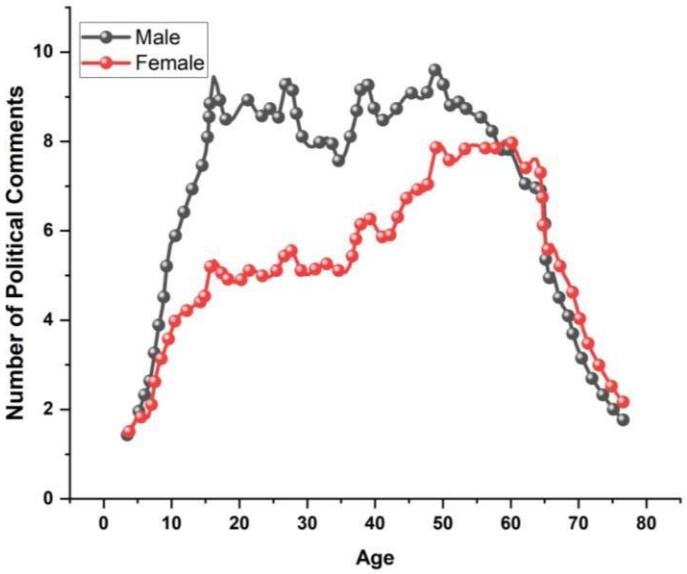


**Figure 4** A graph shows the number of political remarks made on Facebook by male and female users, broken down by age.

**Table 2** Significance of News, Size, and Relationships on Facebook on Political Engagement and Protests.

| | Political Protest | Political Participation |
|---|---|---|
| Certain digressions from the extent of the Facebook network | | |
| Size → News → Express → Efficacy | .12* | - |
| Size → News → Express | .02* | .04** |
| Size → News → Efficacy | - | .02* |
| Size → Efficacy | .08*** | .06*** |
| Direct impact | .11*** | .21*** |
| Overall indirect impact | .05*** | .03*** |
| Certain diversion routes from Facebook connections | | |
| Relationships → Express → Efficacy | .02* | .02* |
| Relationships → Express | .02* | .05** |
| Relationships → News → Express → Efficacy | .02* | .02* |
| Relationships → News → Express | .02* | .04*** |
| Relationships → News → Efficacy | .02* | .02* |
| Direct impact | .10*** | .39*** |
| Overall indirect impact | .09*** | .11*** |
| Specific detours from Facebook news | | |
| News → Express → Efficacy | .03** | .02** |
| News → Express | .06* | .09*** |
| News → Efficacy | .04* | .03* |
| Direct impact | - | - |
| Overall indirect impact | .10*** | .13*** |

*3.3. Facebook users and non-users*

To determine the degree to which statistics, political opinions, media use, and political participation may separate Facebook users and nonusers in HK (RQ2), a discriminant function analysis was carried out (RQ2). The outcomes of the discriminant evaluation and the descriptive statistics for the inputted variables are listed in Table 3. Wilks' lambda was significant,$\lambda = .63$, $\chi^2 = 201.07$, p <.001, showing that the collection of factors may differentiate between the two categories. All variables made a substantial contribution to the model, save maybe political attraction, political efficacy, and radio news usage. A closer look at the uniformed function parameters revealed the three most significant distinguishing characteristics were age (.69), education ($-0.32$), and reading online news ($-0.30$). As a result, people who are young, more educated, and more likely to read via the internet news are more likely to use Facebook. Figure 5 displays the findings for Facebook users and nonusers.

**Table 3** Statistics for Facebook and non-Facebook users, together with the results of the discriminatory evaluation.

| | Nonuser | | User | | Comparative evaluation | | |
|---|---|---|---|---|---|---|---|
| | M | SD | M | SD | Performance Coefficients | Correlation Coefficients | Equality of Group Means (p-Value) |
| Political beliefs | | | | | | | |
| Efficacy | 2.05 | .96 | 2.15 | .91 | .08 | −0.08 | ns |
| Interest | 2.15 | 2.05 | 2.11 | 2.01 | .23 | .04 | ns |
| Engagement | | | | | | | |
| Protest | 1.21 | 2.45 | 1.55 | 2.26 | .04 | −0.15 | P<.02 |
| Political participation | 2.37 | 2.17 | 2.73 | 2.35 | −0.21 | −0.19 | P<.002 |
| Usage of media | | | | | | | |
| TV news | 1.64 | 2.73 | 1.07 | 2.51 | .13 | .26 | P<.002 |
| Radio | 2.96 | 1.09 | 2.84 | 2.95 | −0.12 | .08 | ns |
| Newspaper | 2.90 | 2.80 | 2.24 | 2.49 | .09 | .26 | P<.002 |
| Online newspaper | .90 | 1.49 | 2.00 | 1.62 | −0.30 | −0.50 | P<.002 |
| Online TV news | .45 | 1.12 | .84 | 1.28 | −0.07 | −0.25 | P<.002 |
| Demographics | | | | | | | |
| Age | 4.74 | 1.17 | 3.32 | 1.29 | .69 | .82 | P<.002 |
| Education | 4.27 | 1.81 | 5.83 | 1.65 | −0.32 | −0.61 | P<.002 |
| Income | 3.90 | 2.50 | 5.16 | 2.38 | −0.16 | −0.36 | P<.002 |
| N | 350 | | 466 | | | | |

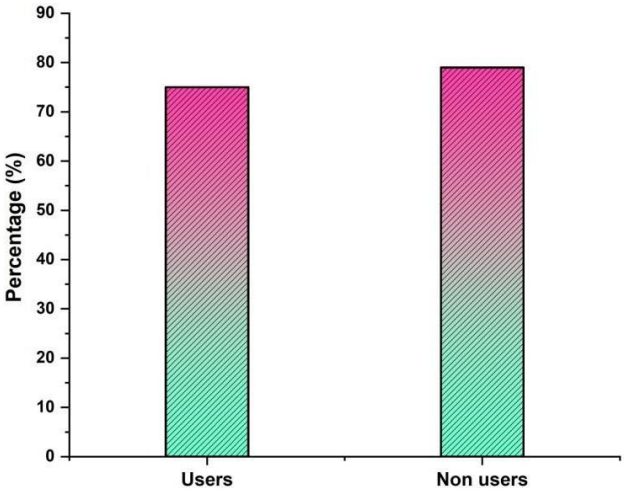


**Figure 5** Users and Nonusers of Facebook.

Despite the fact that protest and political involvement were both substantial discriminators, the function coefficients for these factors were rather modest (−0.12 and.03, respectively). According to categorization findings, the model correctly predicted 79% of Facebook non-users and 75% of Facebook users.

## 4. Discussion

In a city-state that is semi-democratic and where more than 50% of the people use Facebook, this research looked at how these factors would affect political involvement. These factors included the size of the Facebook network, connections to prominent political figures, the use of Facebook for news, and the use of Facebook for opinion expression. For the development of theories and an understanding of political interaction processes, the OSROR model has two advantages. First, the integrative model can assist in bringing together and integrating the numerous significant investigations that have shown correlations between variables that are frequently investigated topics that are often discussed and engaged in separately, such as Internet usage and effectiveness and news and communication, into a complete and logical framework. Second, the method may provide light on the many avenues that could lead to political involvement. It is especially helpful for analyzing SNSs like Facebook since it allows for the systematic placement and analysis of the many informational and interactive advantages of these SNSs, together with the design of users' online communities. A deeper look at the information reveals that 24% of Facebook users were connected to political and social activists. In contrast, the percentage was just 10% for government employees and 17% for political organizations and commentators on political issues. The fact that activists tend to be more connected is reasonable, given that they are often better at utilizing social media to further their causes and gain influence.

The OSROR model reveals not only direct effects but also significant intermediary functions of news and expresses routes. Additional connections equate with greater political power and significant knowledge, providing opportunities for direct connection, which may increase political effectiveness and encourage involvement. The main behavioral difference is that Facebook users are more inclined to participate in politics and demonstrations than nonusers. There are special features on social networking sites that are particularly helpful for connecting with others and organizing group activities, which in turn creates additional chances for political activity. As a result, the findings suggest that there may be a "participation divide" because there may be fewer opportunities for Facebook users to engage in politics. These are, of course, merely early data; whether or not this is the case must be confirmed by larger, longer-term investigations. There is a reason for the hope that the absence of participation may eventually be minimized via the slow process of a generational shift, considering that Facebook use in HK has been steadily growing and that future Facebook users from the present younger demographic are predicted.

## 5. Conclusions

The usage of Facebook news has been shown to have a complicated and multidimensional impact on political beliefs and engagement. While Facebook gives users a place to obtain a variety of news items and participate in political debates, its effect on people's political opinions and actions is impacted by a number of different elements. Examining the factors that most clearly separate Facebook users from nonusers revealed some information on a potential second-level digital divide. Given that these people tend to be early adopters of new technology, it may not come as a huge surprise that Facebook users are often richer, younger, and more knowledgeable. This research has a number of shortcomings that should be noted. First, more Facebook features could possibly contribute to the OSROR model. In future research, increased network heterogeneity, for instance, might add another variable to the first O and provide a wider variety of information and debate. Second, this study's focus is just on Facebook use. Although It is one of the most widely used social networking sites in HK, users also communicate via WeChat and WhatsApp. Despite these drawbacks, this research adds significantly by employing the OSROR model to explain the processes behind various Facebook usages for political involvement and protest. Future studies should take into account and review the system's key characteristics, then evaluate its benefits and consequences using algorithms instead of seeing one platform having significant influence as Facebook or similar online social connections, which might potentially influence decisions regarding utilization with generic measures.

## Ethical considerations

Not applicable.

## Declaration of interest

The authors declare no conflicts of interest.

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Evaluation of public transportation system from the perspective of passengers

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**Abstract** In this research, Nigeria's Akure-Owo Axis public transportation system (PTS) passenger satisfaction is evaluated. It was required because certain Nigerian urban centres' weak transportation infrastructure made it difficult for people, products, and services to move freely. Meanwhile, the significance of public transportation resides in the basic truth that accessibility and mobility are necessary for both economic development and the effective and efficient flow of products and services in cities of many developing nations. There was discovered to be twelve bus services. To gather the necessary data at the terminals (Akure and Owo Park), the research used questionnaires and field observation. Passengers at the two terminals were given one hundred and twelve (112) questionnaires. Standard deviation and weighted mean were used as descriptive tools. Also utilized to provide descriptive statistics was gap analysis. The results showed that passengers were dissatisfied with the drivers' skills, the vehicle's condition, overloading and over speeding, the drivers' attitudes, the drivers' adherence to traffic laws and orders, and the cost of the trip.

**Keywords:** expected service, perceived service, PTS, passengers

## 1. Introduction

Public transportation (PT) is any form of transportation that is accessible to the general public and is run by either public or private organizations. Buses, trains, subways, trams, and ferries are a few examples of PT. An important function is PT for many individuals depends on it to obtain to and from positions such as work, school, the doctor, and others. In addition, since it lessens congestion in traffic and releases greenhouse gases, it is an environmentally friendly substitute for using individual vehicles. According to the area they provide, transit systems come in a variety of sizes and levels of sophistication. Despite some cities have fewer alternatives; some have substantial networks of buses, trains, and subways. PT is crucial for offering populations cost-effective, reliable, and secure transportation solutions. Many times, governmental organizations, such as municipal or regional transit authorities, run PTS. As a substitute, institutions may be run by individuals under government contracts. Government subsidies, taxes, and cost collections are just a few of the sources of funding available for PTS (Leng and Corman 2020). The way various people perceive and engage with their travel experience is referred to as the passenger viewpoint. That may involve things like their attitudes, expectations, and feelings about the means of transportation, the lodgings, and the whole trip experience. Many other things, such as individual preferences, past experiences, and the caliber of the travel experience, have an impact on passengers' perspectives. For transportation providers and travel agencies to match the demands and expectations of their consumers, it is essential to comprehend the viewpoint of passengers. Detailed agreements outline how transit providers and authorities should interact. The operational, financial, and technological standards that operators have to conform to, as well as the consequences of non-compliance, are outlined in the contracts (Canitez et al 2019).

The Chinese government has implemented several changes in recent years to improve the availability of PT and effectively promote PTS. To enhance service and attract new customers, analyzing the many features of PT might reveal the areas where it performs poorly. Therefore, the ability of the PTS to draw in and keep passengers is a key factor in determining its success. One of the most crucial metrics for assessing the state of urban PT is the quality of the service provided (Zhang et al 2019). PTS has made a lot of improvements with the introduction of information technologies. However, the fact that numerous disruptions and uncertainty are one of the technique's biggest challenges. A new framework model for IoT-based PT is offered for better-coordinated transfer solutions that incorporate the scheduling issues of shared taxis, buses, and subways. Utilizing periodic patterns to anticipate transport flow for the study of passenger and traffic flow, mining is offered (Luo et al 2019). The review procedure often involves getting input from passengers via questionnaires, interviews, focus groups, or online discussion forums. It entails taking into account several variables that

have an immediate influence on the happiness, practicality, and efficiency of travelers. Determining how much it costs to use PT in proportion to the income levels of the users and the perceived value they get from the service, taking into account things like ticket costs, tariff schedules, and any applicable discounts. Assessing the connectedness of the transportation network overall and the ease with which passengers may switch between various forms of transportation, such as buses, trains, and other connecting services, to guarantee smooth trips (Liu et al 2021). Evaluation of a PTS from the perspective of passengers refers to evaluating how well the system meets the requirements and expectations of the passengers who use it to get from one point to another. The evaluation can involve various aspects of the transportation system, including its accessibility, reliability, affordability, safety, convenience, and comfort. The assessment may cover a range of transportation-related factors, such as the system's efficiency of use, dependability, expense, security, simplicity, and pleasure (Chen et al 2021). Sazu and Jahan 2022 determined they were sound, adaptable, and diverse enough to be used in big-city transportation systems. The framework will enable system management in a centralized way, enabling far more effective transit among cities. Big data analytics methodologies may be utilized to provide information for practical decision-making and policy development to address the issues posed by the problems of increasing traffic congestion on the roadways. Guillermo et al (2022) examined a structure for modelling information gathered from PT was developed. To connect data and enable the gathering of geographical information while traveling, the Tiger Graph system was employed, and Django Python was used as the web framework for the (geographic insight website 2020).

The main engine of a nation's economy is PT. Instead of counting the number of individuals who drive private automobiles, the actual indicator of a nation's growth is the proportion of people who use PT. Shen et al (2021) provided to share China's experience with PT control and prevention efforts to advance worldwide adaptation to COVID-19. During all nations around the globe begin manufacturing, it will be especially crucial to prevent and manage illness when using public transit. Aparicio et al (2021) utilized trip information to extensively investigate evolving urban mobility dynamics within multimodal PTS. It blends quantitative perspectives with improvements in machine learning. The present COVID-19 epidemic has caused changes to urban mobility patterns in the city of Lisbon, and these changes are being thoroughly tracked using a similar method. Cedar (2021) provided an effort to depict the potential, logistics, and means of mobility for metropolitan areas. The inefficiency of utilizing private cars makes the case that in the future, when autonomous and electric vehicles are developed, PCs will not be able to compete with the potential of urban transportation networks. Grahn et al (2021) presented a strategy for informing such policy using a data-driven manner that specifically examines the relationship between TNCs and bus transit in Pittsburgh. Due to a lack of trip-level data, transportation network companies (TNCs) offer mobility services that invisibly influence travel habits. Their interactions with other forms of transportation may directly affect society, necessitating the implementation of the proper policies. Porru et al (2020) provided insight into the application of smart transportation solutions distinct in rural and urban settings. The region's transportation systems are under pressure to adapt innovative strategies as a consequence of moving demographics in outlying locations. The use of IoT technology has been demonstrated to be a beneficial solution to the movement problems in rural regions and has given rise to the idea of smart land. Yan et al (2019) provided the reactions of users to a suggested integrated transit system. They performed a large-sample survey to gather information on both revealed preference and asserted preference, and then they fitted an RP-SP hybrid logarithm analysis to arrive at the primary factors influencing the choice of commuting mode. Owais et al (2021) integrated the bus and subway systems into a single, interconnected transit network to provide a workable solution to the design issue for a subsurface section. The consistent and non-demand-oriented criterion for the design tries to improve the connectedness of the whole transportation system. According to predetermined demand node pairings, the metro lines are constructed to minimize passenger transfers through the transportation network.

## 2. Study Area

The Akure-Owo expressway connects the western and northern regions of the nation and is a particularly active federal route as a consequence. The road was among the kinds of highways built from Benin to Ilesha in 1965 as pavement dressed, and it underwent its last significant interventions through Akure-Owo in 1998. In 1978, it was transformed into asphaltic concrete. The road's Owo-Akure segment begins at the Ikare intersection in Owo and ends at that place. It is now clear why the road is in such fantastic shape because this stretch has just undergone extensive restoration. However, based on the FGNRSDT study from 2010, it was found that culverts, drains, and bridges are all suffering from varying degrees of scouring and siltation and would need a variety of repairs and upkeep, such as painting and cleaning of bridge bearings, joints, and weep holes. Based on Akure to Owo, 51 km separates the two cities. Iluabo, Ogbese, USO, and Emure are the principal cities along the axis. Benin-Ado Park in Akure and Post Office Park in Owo are two of the significant parks mentioned in the axis. The location of the Akure-Owo is seen on the geographical map below.

## 3. Research Methodology

Due to the average and generic structure of the statistical data types, the study is explanatory. Both primary and secondary sources were employed to get the data. The demographics being studied are the people that use the PT along the

Akure-Owo axis in Nigeria's Ondo State. Passengers who routinely travelled along the axis were given a well-designed questionnaire to complete to gather primary data. The National Union of Road Transport Workers, which coordinates the Akure-Owo axis, provided the daily movement records that were used to calculate the study's sample size. According to the records, there are at least fourteen minibuses that run back and forth along the axis, each of which can accommodate 14 passengers. The number of passengers, which came to 112, was divided by the number of minibuses that run every day. However, throughout the investigation, both random and purposeful approaches to sampling were employed. To guarantee that only passengers who had travelled around Akure-Owo were polled, a purposeful sampling technique was required. The randomized procedure was chosen to guarantee that all participants had the same chance to be sampled for the study. A gap analysis was used to examine the information that was gathered for the study. Comparing expectations and perceptions of quality services was done using gap analysis. The idea behind gap analysis is that, as the difference between expected and perceived services (ES and PS) increases, quality will be viewed as becoming steadily less than desirable. When Expected Service (ES) and Perceived Service (PS) are identical, quality is good. Likewise, when ES is less than PS and PS > ES, quality will become increasingly satisfactory as the PS > ES gap widens. To examine the purpose of this investigation, the weighted average measurements of the expected service (ES) and the perceived service (PS) were contrasted, and a gap analysis depending on the weighted mean amounts has been carried out. In addition, the significance of standard deviation in the research of vision is such that one is unable to overstate. The standard deviation, a measurement that reveals the range of a variable's significance, is important for figuring out if survey respondents are heterogeneous or homogeneous. The period or range given follows has been selected to represent the respondents' perceptions of heterogeneity or homogeneity.

$$\text{Interval} = \frac{\text{Maximum count} - \text{Minimum count}}{\text{number of range}} \quad (1)$$

$$\text{Interval} = \frac{5-1}{5} \quad (2)$$

Interval = 0.8

The amount of pleasure that participants evaluated will differ divided into intervals, with each interval equal to 0.8 for each separate variable, which translates to the following:

Translation of the Rating System

a. 2.60 – 3.39: The passenger is neither satisfied nor dissatisfied.
b. 1.80 – 2.59: The passenger is dissatisfied.
c. 4.20 – 5.00: The passenger is heavily satisfied.
d. 1.00– 1.79: The Passenger is highly dissatisfied.
e. 3.40 – 4.19: The Passenger is satisfied.

In addition,

a. 2.60 – 3.39: The service is good.
b. 1.80 – 2.59: The service is fair.
c. 4.20 – 5.00: The service is excellent.
d. 1.00– 1.79: The service is Poor.
e. 3.40 – 4.19: The service is very good.

The standard deviation of 0.8 is justified because respondent perceptions are homogeneous if the standard deviation in the study is less than 0.8, but heterogeneous if the standard deviation in the study is greater than 0.8.

## 4. Results and Discussions of Findings

In order to determine the optimum outcome, we looked at factors including socioeconomic status of passengers, frequency of travel, cost, and identify the heterogeneity and homogeneity of consumers' perceptions of transportation, number of passengers, service quality, and techniques for enhancing public transportation.

### *4.1. Social-Economic Characteristics of Passengers*

The data in Table 1 provided insight into the socioeconomic makeup of the study's sample of passengers. Sex, age, and level of education are among the factors taken into account. 33.9% of travelers were female and 66.1% of passengers remained male, according to their sex. This demonstrates that men make up the bulk of the travelers along the Akure-Owo route. This may be due to the fact that gender-specific differences in women's mobility and travel activities exist. Gender-specific differences in female movement and travel behaviors exist. In this area, there are discernible gender differences in travel behavior that may be attributed to a variety of circumstances, including age, financial level, society perspective, time, distance, family size, etc. In terms of marital status, there were 27.7% of single people, 48.2% of married people, 17.9% of divorced people, and 6.3% of widowed people. According to the research above, most of the travelers were married. This

suggests that married individuals visit the region more often than persons in other marital status categories. This may be because married individuals must travel about to take advantage of opportunities to satisfy their daily needs and support their household. An analysis of the travelers' ages reveals that 27.7% of them are between the decades of 20 and 30; 44.6% are among the categories of 30 and 40; 18.8% are between the ages of 40 and 50; and 8.9% are over the age of 50. All indications point to the bulk of passengers being in the 30 to 40-year age range. This suggests that people in this age group have a significant impact on their search for employment. This is a working age group that is active and capable of overcoming the intricate difficulties presented by the surroundings. Based on the passengers' educational backgrounds, it was clear that most of them had college degrees. This suggests that the users of the PTS along the Akure-Owo axis were informed enough to share their degree of satisfaction. While most of them expressed the opinion that PT in the region is more affordable than other forms of transportation along the axis, which encourages people to use it. A majority of the travelers on the Akure-owo route were merchants, next to students, professionals, and artisans, according to their employment status.

**Table 1** Socio-economic status of responders.

| Social-Economic Characteristics | | Percent | Frequency |
|---|---|---|---|
| Occupation Status | Student | 22.3 | 25 |
| | Trader | 40.2 | 45 |
| | Professional/artisan | 22.3 | 25 |
| | Civil servant | 22.3 | 17 |
| | **Total** | **100** | **112** |
| Age Status | 20-30 | 27.7 | 31 |
| | 30-40 | 44.6 | 50 |
| | 40 -50 | 18.8 | 21 |
| | 50 and Above | 8.9 | 10 |
| | **Total** | **100.0** | **122** |
| Sex | Female | 33.9 | 38 |
| | Male | 66.1 | 74 |
| | **Total** | **100** | **112** |
| Education Status | No Formal Education | 8.9 | 10 |
| | Primary school | 27.7 | 31 |
| | Secondary school | 18.8 | 21 |
| | Tertiary above 40-50 | 44.6 | 50 |
| | **Total** | **100** | **112** |

*4.2. The regularity of the journey, the cost of travel, and an explanation for using PT along Akure Owo Road*

According to the frequency of passenger travel or movement along the Akure–Owo road, 13.4% of them did not travel along the route regularly, 35.7% sometimes, and 50.9% often. These suggest that the vast majority of the passengers along the axis travel often and, as a result, have a thorough understanding of the route. A majority of the respondents (54.5%), however, asserted that the expense of a trip ranges from ₦600 and ₦500. Figure 1 shows the regularity of the journey, the cost of travel, and an explanation for using PT along Akure Owo Road.

*4.3. The impressions of travelers regarding public transport services such as heterogeneity or homogeneity*

The analysis of standard deviation may be utilized to identify the heterogeneity and homogeneity of consumers' perceptions of transportation. One approach for figuring approximate measurements of dispersion that informs us about the range of a variable's value is the average deviation. According to this model, each people's opinions of a specific service are different or heterogeneous if the average variation is greater than the gap. In similar veins, all participants' perceptions of a specific service are comparable or homogeneous if the standard deviation is smaller than the gap. The analysis and representation of the passenger' perceptions of the PTS are shown in Figure 2 below. According to the descriptive analysis shown in Figure 2 below, all services, except safety, have standard deviation values for service quality and passenger satisfaction that are larger than 0.8. One of the distinctive features of transportation as a derived demand is that passengers felt differently or heterogeneously about the services given when the standard deviation was more than 0.8. Given that passenger safety is seen as crucial in comparison to all other services, it follows that passengers felt similarly about safety if the standard deviation of safety is smaller than 0.8. The passengers' perspective and the state of safety service are comparable.

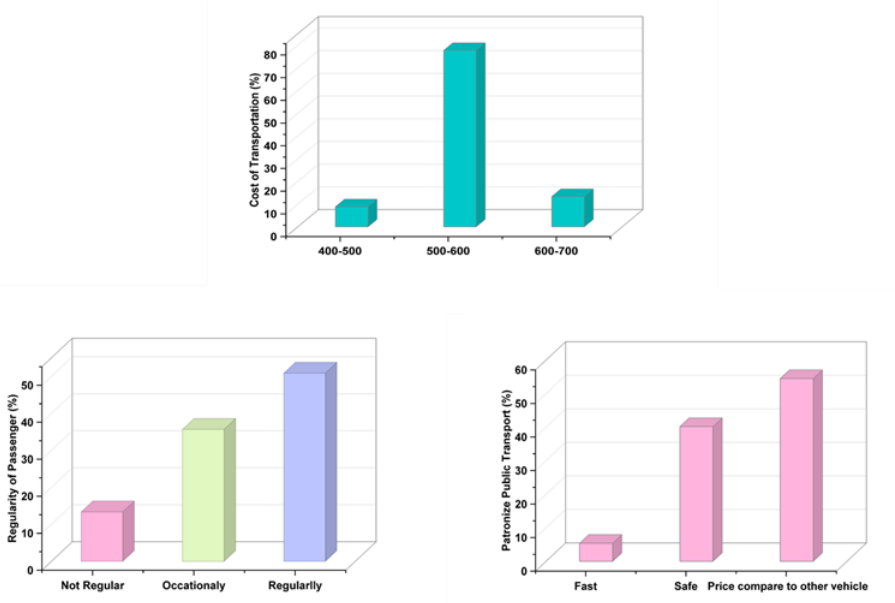


**Figure 1** The regularity of the journey, the cost of travel, and an explanation for using PT along Akure Owo Road.

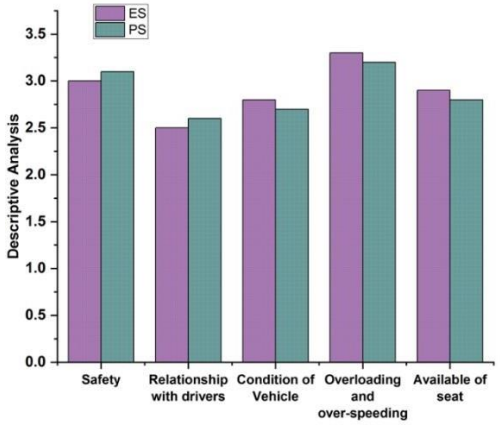


**Figure 2** Service quality and passenger satisfaction descriptive analysis.

*4.4. Passenger Satisfaction Level and Public Bus Service Quality along the Route*

The analysis and representation of the degree of passenger satisfaction and the caliber of the bus transportation service throughout the route are shown in Figure 3 below. According to the gap analysis shown in figure 3 below, passengers were dissatisfied with the skill of drivers, the state of the car, overloaded and over speeding, the drivers' demeanor, the drivers' adherence to traffic laws and orders, and the cost of the trip.

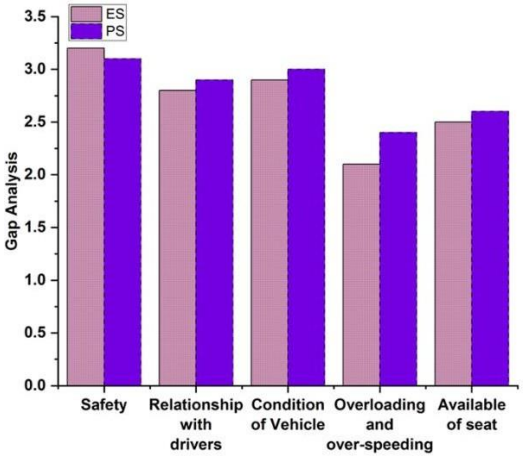


**Figure 3** Gap Analysis of Passenger Satisfaction and Service Quality.

### *4.5. Methods of Improving PT*

The opinions of the passengers on how to enhance the functioning of PT along the Akure-owo axis are shown in Table 2 below. According to the analysis, 49.1% of the passengers recommended driver training, 19.6% supported following traffic laws and orders, 17.9% advocated routine vehicle maintenance, and 13.4% suggested lowering transportation costs and improving relationships between drivers and passengers. According to the investigation, the majority of passengers believed that educating drivers would enhance PT in the study region. The foregoing was supported by the observation that well-informed and educated PT drivers will go a long way toward lowering the number of accidents that take place on the road.

**Table 2** Precision outcomes with different techniques.

| S/N | Ways of Improving Public Transport | Percentage | Frequency |
|---|---|---|---|
| 1 | Compliance with Road Safety Rules and Orders | 19.6 | 22 |
| 2 | Others | 13.4 | 15 |
| 3 | Regular Maintenance of Vehicle | 17.9 | 20 |
| 4 | Training of Drivers | 49.1 | 55 |

## 5. Conclusions

The majority of the passengers agreed that training the drivers, followed by compliance with road safety rules and order, will improve the public transport system in the study area. This study carefully assessed the passengers' satisfaction with the public transport system in the Akure-Owo Axis, Nigeria. The results showed that the price of public buses is less expensive than other vehicles. The results also showed that passengers along the Akure-Owo axis were dissatisfied with the following service indicators: driver competence, vehicle condition, dependability, overloading and excessive speeds, and driver altitude, adherence to traffic laws and order, and cost per journey. The Federal Road Safety Corps (FRSC), educational institutions that specialize in transport management, and the National Union of Road Transport Workers (NURTW) should work together to conduct periodic training, tests, and seminal for public bus drivers to address the issues. This will boost their efficiency and dependability as well as their ability to interact politely with passengers while going about their daily business. Before a public bus is permitted to be utilized for public usage, notably for transportation passengers, FRSC shall control and inspect its conditions. This will minimize any unnecessary delays that can happen from a car breaking down in transportation. Similar to what was said above, the FRSC's efforts to control bus loading and speeding need to be strengthened. As a result, there will be fewer accidents on the road. The FRSC should monitor drivers' adherence to traffic laws and instructions to prevent accidents on our roads. It should be mentioned that certain FRSC officers have been known to accept payments from drivers who break safety regulations. The people (passengers) should be given more authority via a whistleblowing strategy by reporting such instances to the head of operations and anti-corruption authorities to checkmate this. This will advance the sector's return to sanity and create a society devoid of accidents. A scientific technique for calculating the cost of transportation per trip should be developed by the public and private partners, including the transport research institution. This will put a stop to the nation's notoriously persistent transportation expense rise.

### Ethical considerations

Not applicable.

### Declaration of interest

The authors declare no conflicts of interest.

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Assessing the relationship between employment opportunities and criminal tendencies of educated youth

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**Abstract** This research examines the hypothesis that criminal activity has increased behavior among knowledgeable young people in Lagos state, Nigeria, in response to the unequal employment opportunities in the public sector. The tool that was used for the purpose of data collection was the questionnaire. Through the use of techniques including simple random sampling and sophisticated sampling, 1900 individuals overall and four geographical regions were selected accordingly. The Statistical Package for the Social Sciences analyzed the acquired data. According to the study, uneven access to work prospects is a key factor contributing to the rise in juvenile delinquency in Lagos. The study's findings indicate that the disparity in hiring practices for open positions in the broader public sector is the cause of the rise in criminal activity among educated Nigerians in Lagos. Consequently, the report recommends that the hiring process in various government entities follows legal procedures and that a supportive business climate that promotes small and medium-sized firms be created.

**Keywords:** job opportunity, criminal behavior, unemployment, educated youth, education

## 1. Introduction

The rates of property crime and violent crime normally rise with age throughout adolescence, reach their highest point during the latter years of teenage hood, and then begin to fall after that point. This overarching trend was first noticed by Quetelet in the late 18th century and continues to be consistent with both the official arrest rates and the self-reported offense rates today (Steffensmeier et al 2020). The age–crime characteristic is one of the correlations in criminology that has received the most attention and research. Even though it has received less attention, the connection between schooling and criminal behavior is just as intriguing. More than two thirds of the males who were arrested in the year 1993 had not completed their high school education. Self-reporting and arrest statistics show striking disparities across educational categories regarding rates of both property crime and violent crime (Weaver et al 2019).

Adolescence is a time when delinquent conduct is frequent, and a lot of it includes infractions like small theft and underage drinking. Which authorities may easily ignore and whose long-term impact is minimal. But teenagers are also engaged in significant delinquency, which may have unfavorable effects. Society's response to juvenile misbehavior might differ and lean more toward rehabilitation or punishment (Carter 2019). In the late 1990s, for example, moral panics about teenagers acting as violent super predators and tough-on-crime measures were prevalent. Educational institutions and companies established an emphasis on handling risks and a zero-tolerance stance toward law-violating conduct during this time, paralleling the punitive change in criminal justice policy (Hullenaar 2021).

When there is a higher level of employment, there is a proportionate reduction in the availability of acceptable targets since individuals have fewer opportunities to snip. The leading cause of a rise in crime is unemployment, especially long-term unemployment that lasts for an extended period across an economy. There will be fewer chances for legitimate work if the unemployment rate rises, and there will be more criminal activity since jobless individuals find it more affordable to engage in illicit activities. The eradication of human pleasure in countless spaces and the widespread, long-term impact it has on society is both caused by unemployment (Kassem et al 2019).

In addition, several studies have shown a connection between unemployment, criminal activity, and other forms of social dysfunction in Nigeria and other nations. For instance, researchers discovered a connection between the overall percentage of unemployment and the number of possibilities and motivations for criminal activity. Additionally, the study found that a higher unemployment rate is positively correlated with an increase in property offenses (Lee 2018). The paper (Javdani 2019) aims to (a) advance by conducting a systematic review of social science literature with a focus on peer-

reviewed studies about education, psychology, and juvenile justice; (b) develop an approach for evaluating the efficiency of schools law enforcement training courses; and (c) develop a framework for evaluating the performance of school police departments.

The study Cameron et al (2018) provides a comprehensive evaluation of quantitative research on the same subject. The information that has been accumulated as a consequence of these quantitative investigations being carried out in a variety of nations is dispersed and incomplete. To provide evidence-based recommendations to educate policymakers, services, and future research, reviews and synthesis of the previously conducted research are required.

Based on earlier studies in Iran, the study examines the link between crime and unemployment. It compiles findings from 20 researches on the connection between unemployment and crime using meta-analysis methods. It has been utilized to explain the diversity in study results to employ categorized studies and contextual variables in the shape of moderators. In times before and after 2006, the moderator of various periods examined the impact of unemployment on crime (Mir Mohamad Tabar and Noghani (2019). The study Britto (2022) makes use of in-depth individual-level data that links employment paths, criminal histories, and welfare registries for the whole population of male workers in Brazil to examine the effects of job loss on crime and the mitigating function of unemployment benefits. Workers laid off in large numbers have a 23% higher chance of committing a crime on average than their sons who live with them. The study estimates how a worker's lack of employment will affect criminal behavior. The study (Bennett and Ouazad 2020) constructs each employee's history of job segregation, unemployment, and criminality using a matched employer-employee continuous data set on joblessness, criminal activity, and taxes for all citizens of Denmark. The article's main concern is displaced workers: high-ranking employees who get laid off. The paper (Hazra 2020) proposed a linear regression model with panel-corrected standard errors is used since there is evidence of both heteroscedasticity and cross-sectional dependency. According to the finding of the study Parida (2023), the government of Punjab should take measures to reduce levels of unemployment and population density while also working to increase the number of remittances that are invested in industrialization and social infrastructure. This would help bring about a drop in criminal activity.

The study (Jawadi 2021) shows a strong relationship between unemployment and crime in a four-variable time-varying VAR framework, taking into account both violent and non-violent crimes through the identification of four shocks: joblessness and output, migration anxiety, and crime shocks. According to the paper Wajim (2020), a lack of economic possibilities encourages young people to participate in racial strife and illegal acts like theft and armed robbery. The research suggests that the government increase employment possibilities and industries so that young unemployed may also benefit and help satisfy their immediate requirements. The paper significantly reduces ethnic strife and youth unemployment-related criminal activity.

The rest of the essay is available here, the suggested approach is explained in Section 2, the results are presented in Section 3, discussion is discussed in section 4 and the paper is concluded in Section 5.

## 2. Materials and Methods

In this section, we discuss in detail about assessing the relationship between employment opportunities and criminal tendencies of educated youth. For educated adolescents, in particular, a lack of work prospects may cause dissatisfaction and despair. When people put in the time and effort to get an education but have trouble finding a job that suits them, it may make them feel despondent. Some people may turn to criminal activity to escape this dissatisfaction to satisfy their social or financial requirements.

Even with education, there may still be a gap between the abilities that educated young possess and what the labor market requires. Despite holding a degree, there may be underemployment or unemployment if there is a large skills mismatch. This mismatch's frustration might lead to emotions of discontent and desperation, which could increase the likelihood of being involved in illegal activities.

### *2.1. Study area*

Lagos State is located in the southwest of Nigeria. It had boundaries with the Ogun state in the northeast and east and the west with the People's Democratic Republic of Benin. Lagos has a total area of 3,577 square kilometers, of which lagoons and creeks occupy 787 square kilometers. From an administrative standpoint, it is divided into five divisions comprising 20 Local Government Areas. The commercial center of Nigeria has traditionally been regarded as the state of Lagos. This study focused on four areas of Lagos where youth unemployment and criminal activities are prevalent. The study's participant audience for this study consists of all educated teenagers between the ages of 25 and above who are unemployed (or underemployed) and who reside in the specified areas.

### *2.2. Sampling technique*

With intention, a straightforward random sampling approach was adopted. Using the sample that was the intended method, four Lagos areas where juvenile criminality has been extensively publicized were selected. In comparison, 1,019

individuals were chosen from the chosen locations using simple sampling. The characteristics used include age, educational level, and employment status.

*2.3. Data collection*

Primary as well as secondary sources of data were used in the investigation. A cross-sectional survey study approach served as the main source. The study tool utilized to gather data submitted by the people who participated was a structured questionnaire. Three experienced research assistants helped with the questionnaire administration. The additional sources include earlier scholarly work, statutes and legal documents, news articles, and internet resources. The difficulties of unemployment, uneven work prospects, and the pervasiveness of crime in Nigerian communities were clearly understood by evaluating these sources.

*2.4. Data analysis*

This study's approach to data analysis focused on a combination of descriptive and inferential techniques. Statistical Packages for Social Sciences (SPSS) was implemented to test how much impact an uncorrelated variable has on an associated variable, and simple percentages, as well as frequency measurements, were used to analyze the demographic data of the people who participated and responses relating to the goal of the study.

*2.5. Ethical Consideration*

It has become essential for social scientists to respect ethical principles while doing research. Research ethics consequently set boundaries for this study. As a result, participation in this study was optional. The permission of the respondents was requested, and they were all given sufficient information regarding participating in the research as well as the objective(s) of the investigation. These enabled students to comprehend the consequences of their involvement and their freedom to leave the research if they choose.

Additionally, the information's confidentiality and anonymity were ensured. The questionnaire that was employed was not designed in any way to include questions that may identify the identities of the people who responded or be able to be traced to any of them. Additionally, the researcher had no access to the respondents' personal information. As a result, all data gathered was anonymous. Additionally, respondents received a promise that the information they supplied would be kept private and only be utilized for this research project and, maybe, it's publishing.

**3. Results**

The outcomes of the main data acquired via the used questionnaires are presented and analyzed in this part. One thousand nine hundred questionnaires were distributed, and 1792 were returned and filled out. The 1792 returned surveys were the focus of the study and debate. The even distribution of respondents' demographics is shown in Table 1. Figure 1 shows the respondents' perceptions of creating employment in the country distributed. It is clear that 38% of responders were female, and 62% were men. Additionally, 24% of respondents were between the ages of 26 and 30, 38% were between the ages of 31 and 35, and 21% were between the ages of 36 and 40. This implies that most responders were between the ages of 31 and 35.

**Table 1** Results of respondents' perception of job creation.

| Factors | Value (%) |
|---|---|
| Very High | 16 |
| High | 21 |
| Moderate | 38 |
| Low | 19 |
| Very Low | 6 |

In addition, 56% of people were widows or widowers, and 50% were single. Additionally, 32% had a university bachelor's or higher degree. Additionally, 36% of people were underemployed, and 68% were jobless. These findings show that single, educated, and jobless respondents comprised most of the sample.

Table 2 displays respondents' perceptions on the degree of employment creation in the government sector (at the level of the federal, state, and municipal governments). Figure 2 shows the allocation of participants' perceptions of equal opportunity in the civil service employment procedure. The findings suggest that 38% of respondents believed that generating jobs in public service was moderate, while 16% and 21% said it was very high and high, respectively. Meanwhile, 19% and 6% believed it was low or very low. These findings indicate that the vast majority of those polled believed the degree of job creation in the civil service was around average. In other words, it is neither high nor low.

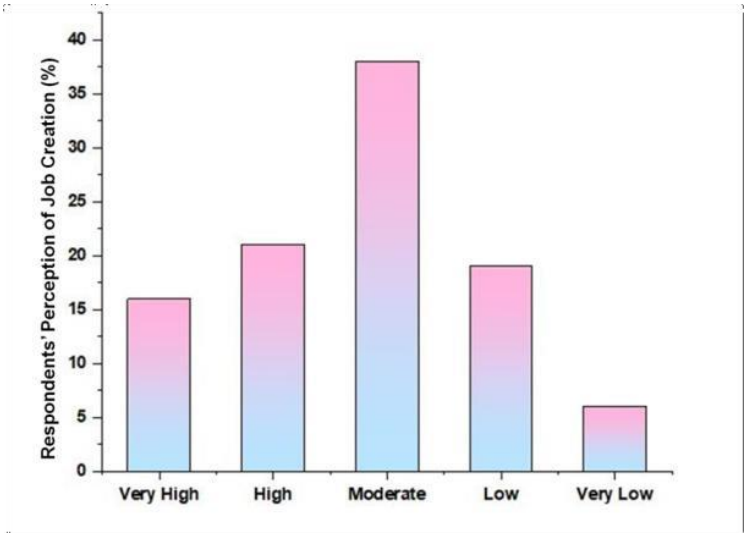


**Figure 1** Respondents' Perceptions of creating employment in the Country Distributed.

**Table 2** Results of respondents' perception of equal opportunities.

| Factors | Value (%) |
|---|---|
| **Strongly Disagree** | 42 |
| **Somewhat Disagree** | 36 |
| **Neither Agree nor Disagree** | 22 |
| **Somewhat Agree** | 2 |
| **Strongly Agree** | 1 |

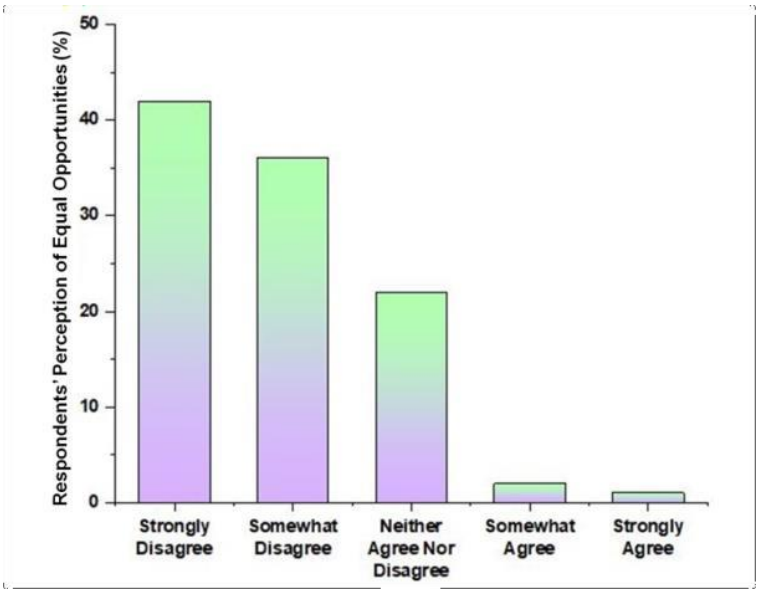


**Figure 2** Allocation of participants' perceptions of equal opportunity in the civil service employment procedure.

The respondents' impressions of equal opportunity throughout the recruiting process for the Nigerian public service are shown in Table 2. According to the data, 22% of respondents are unsure, 43% of individuals completely disagree, and 38% of individuals are somewhat skeptical that there are no equal opportunities in the hiring process. According to the results, most respondents said that Lagos State's competent Nigerians did not face an equal opportunity to compete for available posts in government-affiliated organizations (civil service) at all levels. Figure 3 depicts the respondents' perceptions on the major factors contributing to their unemployment and insufficient employment. Table 3 displays the replies provided by respondents to the query on the main cause of their unemployment and underemployment. The results showed that 23% of respondents believed that the lack of appropriate jobs in the nation's economy was a major factor, 38% said that unequal recruitment opportunities in the civil service were to blame, 10% that the poor economic situation and unfavorable business environment were to blame, 4% that poor policy formulation and execution were to blame, and 8% and 17% that inadequate government agencies independence and the lack of private enterprises in the country were to blame.

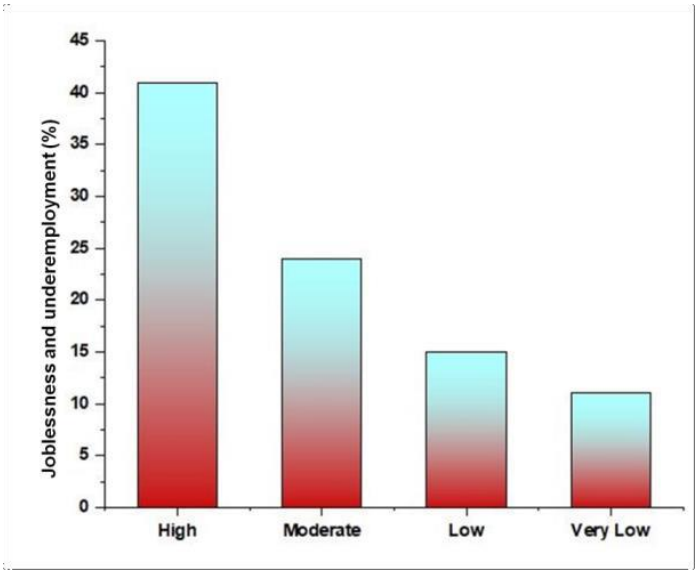


**Figure 3** Respondents' perceptions on the major factors contributing to their unemployment and insufficient employment.

**Table 3** Results of Joblessness and Underemployment.

| Factors | Value (%) |
|---|---|
| High | 41 |
| Moderate | 24 |
| Low | 15 |
| Very Low | 11 |

This implies that many respondents thought that uneven job opportunities in public service were a contributing factor. The respondents' perceptions of the degree of juvenile crime in Lagos City are shown in Table 4. Figure 4 shows the respondents' views on the amount of youth crime in lagos city. Results indicated that all respondents considered that juvenile crime in Lagos was low or very low, whereas 35% and 41% thought it was very high and high, respectively, while 24% thought it was moderate. This suggests that a higher proportion of respondents thought Lagos City had a high rate of juvenile crime. In answer to the inquiry of whether the rise in young crime in Lagos is a result of uneven job possibilities throughout the hiring process, the respondents' views are shown in Table 5. Figure 5 depicts the respondents' views on the rise in youth crime as a reaction to unequal chances for employment in the civil service It can be seen that 19% additionally disagree or agree. In comparison, 38% and 24% partially agree and strongly agree that the rise in youth crime in Nigeria's Lagos State was a consequence of or reaction to the inequitable possibilities for employment in the civil service. 6% and 13% of respondents completely disagree and slightly disapprove of this statement, respectively.

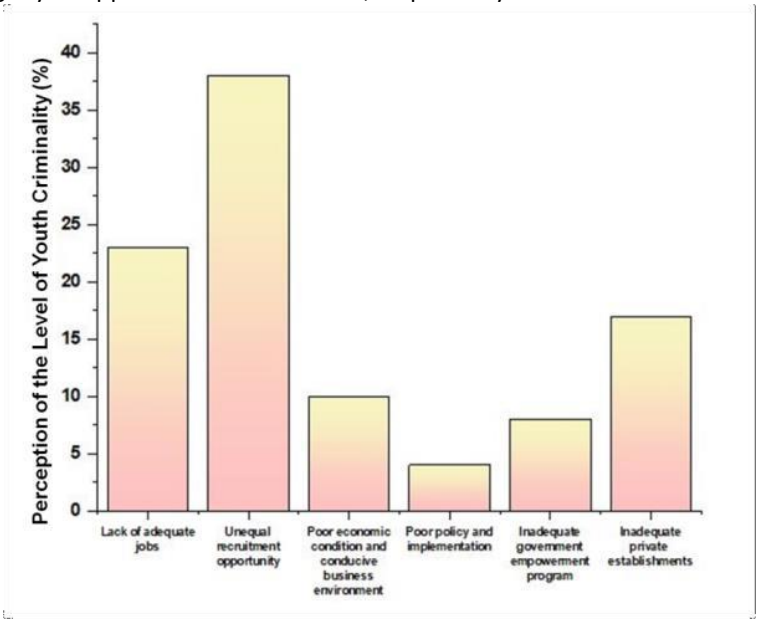


**Figure 4** Respondents' Views on the Amount of Youth Crime in Lagos City.

**Table 4** Results of perception of the level of youth criminality.

| Factors | Value (%) |
|---|---|
| Lack of adequate jobs | 23 |
| Unequal recruitment opportunity | 38 |
| Poor economic conditions and a conducive business environment | 10 |
| Poor policy and implementation | 4 |
| Inadequate government empowerment program | 8 |
| Inadequate private establishments | 17 |

**Table 5** Results of unequal job opportunities in Civil Service.

| Factors | Value (%) |
|---|---|
| Strongly Disagree | 6 |
| Somewhat Disagree | 13 |
| Neither Agree Nor Disagree | 21 |
| Somewhat Agree | 32 |
| Strongly Agree | 28 |

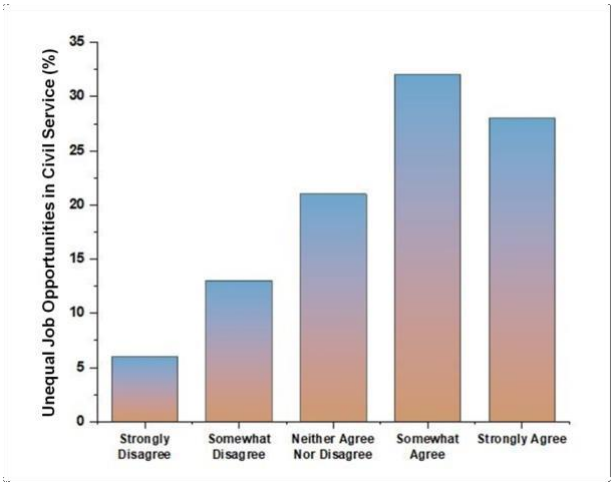


**Figure 5** Respondents' views on the rise in youth crime as a reaction to unequal chances for employment in the civil service.

## 4. Discussion

The goal of the current research was to determine if the spike in young crime in Lagos State, Nigeria is a reaction to the uneven job prospects in the country's public service recruiting process at all levels. The majority of respondents, according to the data in Table 1, believed that the civil service was creating modest amounts of new jobs. This implies that some Lagos residents believed that the government had contributed to creating certain employees in the public sector. However, the widespread perception is that the hiring procedure for these positions is discriminatory. That is, qualified Nigerians do not have an equal chance to apply for these positions. However, there are a variety of viewpoints among the respondents about the main cause of their unemployment (and underemployment). However, as shown in Table 4, most respondents believed that uneven job opportunities in the public sector were a significant influence.

In addition, respondents believed that Lagos's juvenile crime rate was high (Table 5). The degree of unemployment seen in recent years may have influenced this impression. Aside from that, salutations. Additionally, many respondents blamed this on the uneven career possibilities in the public sector. In essence, the findings revealed that some young educated Nigerians in the city of the port of Lagos widely believe that there is a disadvantageous environment for them to compete for available positions in the government workforce, which is believed to be one of the most likely places for an average Nigerian to find employment. It is accepted that this uneven opportunity reduced their prospects of landing a job or made it challenging for individuals to get work. Many of them continued to be jobless (or underemployed) as a consequence. Many people seem to have been compelled to take up menial and humiliating tasks (the underemployed) to meet their daily necessities, while others (the jobless) are dependent on their family members.

## 5. Conclusions

The Nigerian government has diligently addressed poverty and unemployment as key socioeconomic issues for decades. These issues have been addressed in a number of employment creation and empowerment projects. In spite of this, statistics from recent data indicate that a higher percentage of Nigerians are now living in poverty and that most young, trained Nigerians are unemployed or working part-time. Although it is true that there are not enough qualified Nigerians to

fill all the open positions in the public sector, analysts have asserted that corruption among those in positions of authority (government) is a major contributing factor to the rise in unemployment (and poverty) in Nigerian states. These individuals use their positions to favor those who support them by giving their friends, family, and other acquaintances access to employment and perks for advancement that are meant for all eligible Nigerians. Therefore, in a culture where success is determined by work status, educated Nigerians who are without a link to or affiliation with any political organization that cannot get a fulfilling job will find it extremely challenging to survive. This group shares neighborhoods with people who, through associations or other means, have landed jobs with respectable pay that enable them to support their families, send their children to school, purchase automobiles, and meet other needs. These people typically share the same educational background as them or were once their classmates.

**Ethical considerations**

Not applicable.

**Declaration of interest**

The authors declare no conflicts of interest.

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# The impact of diverse workers on job performance in the IT firms: A quantitative study

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**Abstract** The purpose of this research was to examine how diversity in the workplace affects productivity in the information technology sector. Workforce diversity may be measured by gender, age, education level, and ethnicity. India's IT sector is among the fastest developing in the world. Diversity in the workplace is a growing concern in today's businesses, presenting both a problem and an opportunity that, if mishandled, may harm productivity; various people have various viewpoints and biases, just as they vary in gender, age, education level, and race. Analysis of existing works, along with interpretation of data gathered from additional sources, was used to conduct the research. The purpose of this exploratory research is to get insight into the participants' decision-making processes by probing their beliefs and values. Two hundred people filled out an organized survey that yielded useful information. The effect of staff diversity in terms of age, gender, and level of education on IT firms' productivity was investigated using correlation analysis and analysis of variance. It has been determined via research and analysis that a well-managed diverse staff is an asset to any company, helping to boost output and efficiency.

**Keywords:** workforce diversity, employee performance, job performance, worker diversity

## 1. Introduction

The competence and leadership of a company's human resources are crucial to achieving its objectives. Human resource (HR) job satisfaction is highly impacted by HR quality variables and management techniques, including HR growth and job performance oversight. Job success is a function of one's network, skills, and understanding of one's place in the company, so the theory goes. An individual's level of physical and mental energy used while doing their job responsibilities is a direct effect of their degree of Work Drive. The research results indicated that workers' productivity in the workplace might be enhanced by providing them with better training opportunities. Investing in staff development and inspiration is essential for any business that wants to see a rise in productivity from its workforce (Haryono et al 2020). Human resource management (HRM) that is efficient and long-lasting relies heavily on the input of those directly involved in the business and the employees. HRM has to be rethought in light of current difficulties, with long-term sustainability being an improved approach to accurate HRM. Common goals and outcomes are the focus of responsible management of human resources. This includes but is not limited to taking care of team members and the surroundings, staff engagement and growth, outside collaboration, adaptability, adherence to employment laws, collaboration among staff members, fairness, justice, and financial viability (Davidescu et al 2020).

Although the repercussions of stress in psychology are well-described, fewer considerations have been paid to the factors unique to behavioral health employment that raise the risk of exhaustion, together with additional aspects of interest, including intentions to leave and fulfillment with work. It has been found that mental health professionals experience interactions between exhaustion, job fulfillment, and desire to leave, which aligns with findings from studies on other labor force demographics. Both stress and the purpose of leaving one's current work are connected positively, whereas both are inversely related to contentment on the job. There is a correlation between burnout and issues, including lack of companionship at work, heavy workloads, a lack of control over one's own time, and negative interactions with customers (Scanlan and Still 2011). The ethnographic study conducted at an architecture company and an overnight camp led to the formulation of the notion of staff involvement. A worker's degree of involvement is measured by how much of oneself they bring to their job regarding their body, mind, and emotions. His definition of teamwork was the adaptation of what employees bring to work roles provided an in-depth examination of the many factors that contribute to the definition of participation, including individual characteristics, workplace participation, and corporate citizenship. Therefore, they have provided all the essential ideas linked to staff involvement (Ismail et al 2019). We find that (a) institutional autonomy and (b) multisource evaluation are two HR approaches that may enhance efficient communication among employees of different

backgrounds. Human resource approaches that emphasize the value of fellow workers and foster an atmosphere of acceptance and respect within a company hold considerable promise as tools for managing employees from various backgrounds. Recent developments in organizational structure favoring more individual initiative and adaptability have boosted the profile of institutional power and multisource evaluation. The efficacy of these HR approaches for handling employee diversity is worth exploring, especially as more businesses want to enhance their operations by implementing them (Lee and Kim 2020). Academics and practitioners alike have been paying increasing attention to the importance of job fulfillment as a worker's result. Job fulfillment is defined as an assessment regarding the kind of enjoyment that a staff member comes from their position, which consists of emotional and intellectual components. Both favorable and adverse sensations regarding labor and the organization can influence worker conduct, influencing the successful execution of the company's commercial tactics. An employee's outlook on the work they do is measured by their level of happiness at work. When workers are happy in their roles, they are more likely to have constructive attitudes. However, if they are unhappy with the way they are expected to carry out their responsibilities, they may develop a pessimistic outlook on their job (Mickson and Anlesinya 2020).The Quantitative Study for the Impact of Diverse Workers On Job Performance In The IT Firms

**2. Related work**

The current investigation is on the influence of human resources management on the efficiency of governmental agencies. Government organizations strive to advance their efficiency by reducing costs, extending services and operations, and enhancing superior to succeed in a constantly shifting financial climate that includes developments like internationalization, expanding requirements of consumers and shareholders, and boosting services in a fierce rivalry. The investigation was analyzed using a method of quantitative inquiry. 240 participants were chosen as the group of participants' size for this analysis. Out of the five hypotheses tested, only one that Decentralization has a favorable relationship with company efficiency, was supported by the data. Therefore, it was determined that dispersion contributes positively to company efficiency (Anwar and Abdullah 2021). Employees of universities that are both publicly and privately owned participated in the survey. Simple and numerous regression tests show that staff involvement and work efficiency are positively influenced by their happiness with interaction, and work fulfillment positively influences staff involvement and work efficiency. There is no proof; however, that contentment with ways of communicating has any effect on productivity in the workplace (Pongton and Suntrayuth 2019). The most studied subject in corporate and company psychology is how to increase workplace happiness. Professionals and researchers are beginning to appreciate work happiness for its insights into improving company performance. This section examined the research on employee happiness in the workplace. To begin, we trace the development of the concept of work pleasure and how it has been explained and developed through time. We next detail the different measuring methodologies and methodologies, as well as key assessment factors, for gauging employee contentment on the job. Third, we examine what factors and outcomes contribute to a happy workplace. Finally, we recommend additional studies on job fulfillment by synthesizing findings from the last few generations (Judge et al 2020). There has been a rise in studies examining the effects of having a workforce that spans many generations on businesses worldwide. There has been a lack of empirical investigation into the processes that could underlie the correlation between different ages and the effectiveness of organizations in previous studies. We argue that interpersonal and social assets are the mechanisms via which age variation impacts the efficiency of organizations. We also look at how gender-inclusive leadership and cultural diversity in the workplace influence the ways in which diversity of age impacts social and human assets. We evaluated our assumptions using responses from a large survey of managers conducted by the Association for managing human resources.

A beneficial connection between various ages and company efficiency was found, with the relationship being mediated by higher levels of social and psychological capital. The beneficial benefits of age variety on human and social capital were further bolstered by functional variety and gender-inclusive leadership (Li et al 2021). Because individuals and their expertise are among the most essential factors determining the organization's efficiency, HRM has gained prominence in the modern corporate world. Morale assessment is a crucial part of HRM. Enhancing efficiency, adaptability, excellence, and recognized performance requires businesses to ensure good worker happiness. The purpose is to investigate what factors contribute to job happiness and drive. The impact of the business atmosphere on morale is also discussed. Professional contentment, intrinsic drive, and variable pay all features heavily in the philosophical foundations of this theory. The open lines for interaction between workers and superiors are one of the company's greatest strengths (Ali and Anwar 2021). The study applied the ideas of self-determination and the reinforcement approach to the study of motivation to examine the effects of incentives on workers' productivity. Work efficiency is evaluated based on both job duties and local characteristics, while incentives and rewards are studied from both internal and external viewpoints. The role of job happiness as a mediator between inspiration, incentives, and achievement in the workplace has additionally been studied. Investigators gathered information from both production and service company managers and workers (Kumari et al 2021). The principal information was the main source of information for the research, and the survey was the main means of data collecting. Staff dedication in production companies increased substantially when earnings sharing were implemented. In contrast, staff members' workplace principles increased greatly when flat rate structures were implemented, and unity

among workers increased considerably when incentive programs were negotiated through labor negotiations. The results showed a correlation between incentive programs and productivity in the workplace. This connection affords businesses the chance to harness the incentive provided by the system of bonuses to steer worker behavior in a more productive and efficient direction. According to the results, it was advised amongst others that compensation systems for manufacturers need to be developed so that workers have the right to portions of the profit made by the company as a method of fostering creativity and unity among members (Ngwa et al 2019). It has always been difficult to determine the worker efficiency on the job affects the worth created and captured by a company.

The literature on micromanaging has largely ignored the question of how much of a worker's worth creation genuinely belongs to the company that hired them. At the same time, the field of macroeconomics has largely ignored the nature and forms of individual achievement and collectively efficiency procedures inside organizations in favor of a concentration on value generation and preservation. Therefore, we present an idea that predicts the manner in which businesses are going to extract value through worker efficiency by theoretically integrating strategic leadership concept about value generation and acquisition with psychological research on individual job accomplishment and overall success (Call and Ploy hart 2021). Managerial qualities, staff motivation, and productivity on the work were all investigated. The research surveyed relevant scholarly works that provided the conceptual basis. The research was qualitative in nature, and questionnaires were sent out to employees at a subset of Nigeria's consumer goods manufacturers. The research revealed a comprehensive relationship between managerial traits, staff involvement, and work effectiveness via the use of Partial Least Square (PLS) route modeling. The framework shows that among transitional leadership, transactional leadership, and staff involvement, there is a large and moderate link. The level of involvement among workers was shown to be inversely related to pay. A greater degree of staff efficiency may be achieved via the use of transformational leadership as opposed to traditional management (Adeniji et al 2020).

**3. Differentially essential factors in the labor force**

Diversity is more than just accepting and even celebrating variety. Diversity may be defined as a deliberate collection of behaviors that includes:

- Realizing, including valuing the interconnectedness of all people, civilizations, and the physical world.
- Putting into practice a shared appreciation for one another's unique characteristics and life lessons. Recognizing that there are many methods of knowing along with various techniques of behaving;
- In light of the knowledge that bias of a hidden, social, or organizational nature develops and maintains benefits for some at the expense of others,
- We need to collaborate collectively to end all forms of prejudice. Thus we must forge coalitions across lines of diversity.

Consequently, understanding variation requires connecting to traits and circumstances which transcend related to us and beyond the communities in which we participate. These can involve, but are not restricted to, factors such as age, socioeconomic standing, gender, physical abilities/qualities, race, sexual orientation, religion, gender expression, and place of birth, level of education, profession, revenue, legal situation, parental position, and career history. Finally, we realize that no one culture is inherently better than another, that classifications of distinction aren't necessarily established and those we accept the freedom to determine one. Thus, a more expansive understanding of variety serves to promote openness and encourage us that there are many reasons to pursue diversity beyond compliance with legal mandates, such as learning from the distinctive viewpoints of employees

**4. Research objectives goals**

- The goal is to learn about and comprehend the idea of Worker Diversification.
- To look at the ever-increasing importance of multicultural administration in the business world.
- The goal is to investigate the relationship among strategies for managing diversity and organizational effectiveness.

**5. Materials and methodology**

The investigation in its entirety is meant to be comprehensive and curious. Evaluation of the existing scholarship and interpretation of data gathered from additional sources were used to conduct the research. The aim of this exploratory study is to find out more about the variables that affect the respondent's decision-making. In this investigation, firm's operations and corporate culture are relevant to understanding the organization's perspective on diversity at work, employee productivity, the primary obstacles to overseeing a global workforce, and other related issues. The research focuses on the effects of diverse staff members on IT organizations, and it finds both good and bad outcomes. Books, journals, periodicals, research papers, and numerous search engines, etc., were used to supplement the current and historical databases of the selected firms. Analysis of the whole project was greatly aided by the information gleaned from reading a wide range of literary books, articles accessible online, etc.

*5.1. Sample size*

The response rate is 200 for every individual.

*5.2. Data set*

- Source material
  A thoughtful survey was used to collect the data from 200 participants.
- Subsequent Information
  The Internet was the most popular and prolific method for data collecting, but knowledge was also gathered via publications, newspapers, and corporate documents.

5.3. Survey Equipment

The questionnaire is the piece of technology that was utilized for the survey.

- Resources for Statistics
  These statistical approaches were used to arrive at the final survey findings.
  - Frequency Distribution
  - Proportional Breakdown
  - The variability Analysis

**6. Predictive Error**

The research is without its own set of caveats. Some limitations were discovered throughout this investigation.

- The term "diversity management" encompasses a wide range of ideas. All the chosen businesses are key players in the Indian IT industry, both nationally and internationally. Only four of India's numerous IT businesses provide data. We also did a poll in cyberspace.
- Indeed, diversity management is a comprehensive and intricate field. The discussion was limited to only those factors. More time and in-depth study are needed to conclude. There wasn't enough time to do a thorough search in this region.
- Another restriction is that findings cannot be generalized:

The sample size of this research, 200 IT workers, was small since it was an experimental one. While this study's conclusions are generalizable within its parameters due to the enormous scope of the specimen, more research into the topic of inclusion in the workplace is needed.

**7. Research and interpretation of results**

*7.1. To investigate the association between gender, age, and skill distribution in the workplace and productivity*

To do this, I have utilized Pearson Correlation to analyze the association among applicant diversity and success in IT firms. There is no correlation between demographic differences in the workplace and productivity.

H0= Null Hypothesis; H1 = Alternate Hypothesis.

Those with a bachelor's degree made up the largest share of participants, followed by those with a master's degree. The lowest educated group, PhD holders made up just small part of the total. There were 4.7% people who had some other degree of schooling.

**8. Interpretation**

*8.1. Pearson Correlation Analysis*

Pearson Correlation Analysis determines the significance of an association between workplace diversity and the Performance of Workers. Assume, as a starting point, that the observed values are not significantly different from the predicted or assumed values. If the above connection is meaningful, then H1 is the alternative. According to Table 1, a Significant F value below 0.05 indicates statistical significance. It follows that H1 is true and H0 is false. The above table reflects an independent study that found that having a diverse workforce in terms of age, gender, and level of education is positively correlated with productivity. Table 1 displays the results of a Pearson Correlation Analysis. Therefore, the above table reflects the correlation study that established a favorable association between age diversity, gender diversity, educational diversity, and worker efficiency. Figure 1 illustrates the level of education by graduation.

*8.2. To provide a picture of how IT workers feel about diversity in the workplace.*

To accomplish the study's secondary goal, I have utilized One-Way ANOVA to draw a picture of how IT workers feel about diversity in the workplace.

H0 = Null Hypothesis; H1= Alternative Hypothesis.

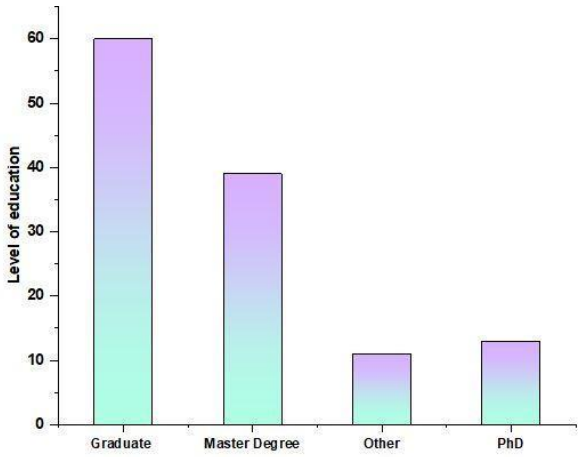


**Figure 1** The Level of education.

**Table 1**Parental demographics include occupation, education, and parenting philosophy.

| Variable | | Employee Performance |
|---|---|---|
| Gender | Pearson Correlation | .143* |
| | Sig. (2-tailed) | .045 |
| | N | 201 |
| Qualification | Pearson Correlation | .143* |
| | Sig. (2-tailed) | .046 |
| | N | 201 |
| Age | Pearson Correlation | .148* |
| | Sig. (2-tailed) | .039 |
| | N | 201 |

## 9. Discussion

To determine whether the age of workers in IT companies is a significant factor, we are employing a One-Way ANOVA test in Table 2. Assume, as a starting point, that the actual numbers are not significantly different from the predicted or theoretical values. If the above connection is meaningful, then H1 is the alternative. According to Table 2, a Significant F value below 0.05 indicates statistical significance. It follows that H1 is true and H0 is false.

**Table 2** ANOVA between Age, Gender, Education.

| Variables | Mean | N | Std. Deviation |
|---|---|---|---|
| **Age** | | | |
| 21-40 | 2.95 | 118 | 1.283 |
| 41-60 | 2.53 | 84 | 1.410 |
| Total | 2.78 | 202 | 1.351 |
| **Gender** | | | |
| Female | 2.53 | 83 | 1.417 |
| Male | 2.94 | 119 | 1.280 |
| Total | 2.79 | 202 | 1.351 |
| **Education** | | | |
| PG | 2.53 | 83 | 1.417 |
| UG | 2.94 | 119 | 1.280 |
| Total | 2.79 | 202 | 1.351 |

Employees' favorable attitudes regarding Workforce diversity are represented in the results of the One-Way ANOVA table above.

To determine whether or if workers' perspectives on the value of acquiring knowledge in IT firms are reflected in their work, we ran a one-way ANOVA on the data represented in Table 3.Assume, as a starting point, that the values you see are not significantly different from the predicted or theoretical values. If the above connection is meaningful, then H1 is the alternative. According to Table 3, a significance level of F of less than 0.05 indicates a positive result. It follows that H1 is true and H0 is false. Figure 2 displays the age distribution of people. According to the data shown above, the youngest participants were under the age of 25 and the oldest were beyond the age of 35. Participants aged 35–45 made up the next

largest demographic, followed by individuals aged 45–55. Workers older than 55 made up a small fraction of the workforce. Therefore, the majority of participants were young people. Employees' favorable attitudes regarding Workforce diversity are represented in the results of the One-Way ANOVA table above.

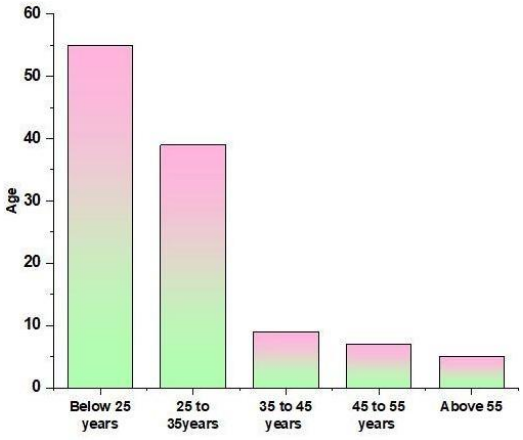


**Figure 2** The Age Distribution.

The global financial system is rapidly spreading to all regions of the globe as an internationalization movement develops. International companies have been instrumental in popularizing the notion of variety and educating their workforce on terms like multiculturalism, gender, and age diversity. Many organizations in the IT sector have made efforts to increase diversity in the workplace. Our findings show that participants enjoy collaborating with a diverse group of individuals in terms of age, gender, culture, and level of education. The acquisition and growth of international skills are facilitated by operating in a multiethnic setting.

People who work for major corporations are interested in learning about other cultures at first but get tired of the effort required. Only a quarter of those polled agreed, while half were vehemently opposed. Employees are naturally inclined to acquire knowledge and adjust when exposed to individuals from other backgrounds. Still, there may be significant gaps between choices and points of view depending on factors such as culture, age, gender, etc. To be clear, workers have the impression; they are being controlled or neglected by superiors. Companies have recently made significant investments in attracting a broad talent pool, but fostering an environment where individuals from various backgrounds can work together successfully presents several challenges. You must carry it out. Diversity in all its forms is the subject of recent studies. It's essential to properly manage the potential for both good and adverse outcomes when different groups work together. There are a lot of potential issues that might develop from having such a varied group of applicants working together. We included questions on these themes in the survey and gathered responses to comprehend staff sentiment better.

**Table 3** An analysis of employee perceptions on age.

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| **Age and Perception of Employees** | | | | | |
| Between Groups (Combined) | 8.652 | 2 | 8.652 | 4.849 | .030 |
| Within Groups | 353.305 | 199 | 1.785 | | |
| Total | 361.956 | 201 | | | |
| **Gender and Perception of Employees** | | | | | |
| Between Groups (Combined) | 8.047 | 1 | 8.047 | 4.503 | .036 |
| Within Groups | 353.910 | 199 | 1.788 | | |
| Total | 361.956 | 200 | | | |
| **Education and Perception of Employees** | | | | | |
| Between Groups (Combined) | 8.047 | 1 | 8.047 | 4.503 | .036 |
| Within Groups | 353.910 | 199 | 1.788 | | |
| Total | 362.956 | 200 | | | |

When workers disagree, businesses should create a diversity management division to mediate. To successfully adopt diversity, organizations must provide their staff with the proper education and training. It's essential to routinely poll workers for their opinions and the most recent data on how they feel about their jobs. Talk it out, and keep your employees encouraged and inspired. Treat all of your staff with the utmost respect and decency.

According to this research, it's not difficult to manage a workforce that spans many generations, traditions, and personalities. OK, then. There are gender inequalities in the workplace that may be taken into account during evaluations of performance and promotions. There are still many glass barriers that women face while trying to advance their careers.

Through literature studies and expert opinion, we selected variables and elements to analyze how employees' perceptions of diversity in the workplace affect productivity. The relationship between cultural diversity and organizational production is seen in Figure 3. Half of respondents strongly believed that cultural diversity promotes organizational productivity, as seen above. 43.5% said cultural variety enhances organizational productivity. 7.3% were indifferent that diversity enhances organizational productivity. Diversity improves organizational productivity, according to 1.6%. The graphic shows that including individuals from different cultures improves output.

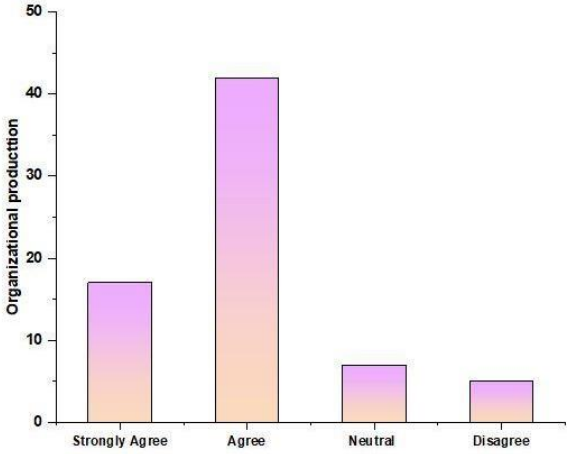


**Figure 3** Relationship Between Cultural Diversity and Organizational Production.

## 10. Conclusions

In the following decades, it is expected that there will be a dramatic increase in the variety of people working in all fields. The diversity of the workforce may provide a fertile ground for the development of new ideas and abilities. Factors such as a lack of qualified workers, a competitive international marketplace, evolving demographics, satisfied customers, a positive public perception of the company's brand, the ongoing need for creative problem-solving, etc., are driving the demand for it. When various groups get close and engage with one another, having a diverse workforce becomes most difficult. They seem to have problems with interpersonal interaction and social cohesion. It's when you need diversity management to help you connect the dots and learn to see beyond the differences. Management should take the initiative to identify diversity-related problems and take action to address them. The study's findings shed significant light on how businesses in the IT sector are currently handling diversity management. Most employees are optimistic about the results of managing diversity. The research shows how important it is for businesses to work with variety to maximize their workers' talents and get an edge in the market.

In this investigation, we sought to understand how employees in Indian IT firms saw the connection between a diverse workforce and their own productivity. The efficiency of workers was shown to be affected by four different aspects of staff diversity, including employees' ages, genders, ethnicities, and levels of education. These aspects of multiculturalism within the Indian workforce are crucial to worker efficiency. They should be carefully studied by management in order to maximize the benefits of a more inclusive workplace.

### Ethical considerations

Not applicable.

### Declaration of interest

The authors declare no conflicts of interest.

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Effective methods for adapted text learning for students with mild to severe intellectual disabilities: Differentiating character comparisons

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**Abstract** Teaching students with mild to severe intellectual disabilities who are early readers or non-readers to interact with grade-level literature is difficult. This article outlines research-based teaching methods for early readers and non-readers who have moderate to severe intellectual disabilities and need modified texts and text comprehension instruction. The study's overarching goal was to evaluate the efficacy of a System of Least Prompts (SLP) procedure and a visual organizer in helping first-grade children with mild to severe intellectual disabilities learn the academic literacy criterion of character comparison. These methods may help instructors create resources and guidelines to encourage student involvement with altered literature. To assess the outcomes, various participants are probed in different ways was utilized. The findings showed that one student learned the skill well using the least graphic organizers and prompts intervention strategy. For two more students, the intervention worked well with some adjustments. All participants kept the ability and applied it generally. Future research directions are considered, as well as any practical ramifications. The research on academic content acquisition and students with MSID is furthered by the findings of this study. Through methodical training and the usage of a visual organizer, students with Mild and severe Intellectual disability were able to replicate prior academic studies in teaching by making quantifiable progress in the learning of a reading benchmark. By being the first to instruct primary pupils with MSID in the standard of character comparison, this research also advances the literature.

**Keywords**: primary students, MSID, SLP, adapted text, visual organizer

## 1. Introduction

In the last ten years, there has been a focus on Academic material, criterion-referenced tests, and teaching for children with Mild to Severe Intellectual Disabilities (MSID) in public school education (Griffen 2017). This demographic of children is required to have access to the common studies lessons and be held responsible in state alternative examinations as mandated by the Each Student Success Act and the reauthorization of the Students with Disability Education Act (Yell 2017). Special education teachers strive to use the most relevant, effective, efficient, and instructive methods for teaching academic standards as researchers develop new evidence-based methods (Figure 1).

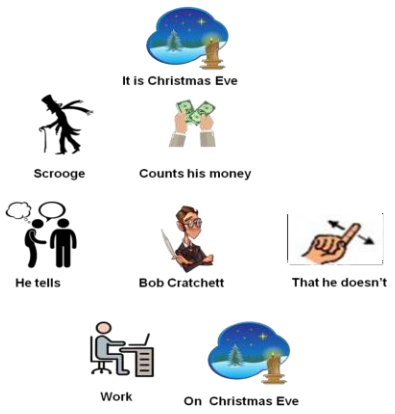


**Figure 1** the Adapted Text Book.

Researchers and educators have created strategies for adapting and training academic standards, such as literacy requirements, so students with MSID may take part in the common education curriculum (Parsons et al 2018). According to current best practices and study, students with MSID have developed their literacy skills using a variety of teaching methods, such as adapted texts that are aligned to grade-appropriate texts, task analysis and read-aloud, shared story reading, the use of visual organizers and methodical teaching that includes response prompting techniques like continuous time lag and the least prompts system. The SLP and a visual organizer have been utilized by researchers as a therapy package to impart academic material. The SLP is a response prompting technique that has been effectively utilized to train academic literacy skills in people with MSID (Griffen 2017). It has also been widely used to educate people with developmental disabilities. With the use of visual and spatial displays that group and illustrate the connections between the topics being learned, graphic organizers help students understand the knowledge being presented. This study's objective was to evaluate an SLP's effectiveness and the use of a visual organizer that was part of the prompt hierarchy. While instructing primary school-aged children with moderate intellectual impairments in the academic literacy benchmark for text comparison.

## 2. Literature Review

Shurr and Taber-Doughty (2017) examined the efficacy of the Picture plus Discussion (PPD) intervention to improve the understanding of expository texts by higher secondary school students with mild impairments. Spooner et al (2019) were to analyze the literature published since 2005 that focuses on the application of evidence-based practice (EBP) principles to the process of teaching mathematics to students with moderate to severe developmental disabilities. Weiss et al (2018) focused on the skills, knowledge, and attitudes required of instructors as they examined the need for educating children with moderate and severe intellectual impairments in inclusive and special education settings. The purpose of the research was to look at the children's routine physical activity. Wouters et al (2019) comprised 68 children and adolescents (2–18 years old) with moderate–severe intellectual disabilities. Knight et al (2020) aimed to summarize current scientific education studies for children with intellectual disabilities and intellectual disability/autism (2009–2018). Wouters et al (2020) examined the connection between physical activity and motor development and physical fitness in children with intellectual impairment (ID) and evaluated their health-related physical fitness.

Kapsal et al (2019) aimed to quantify the positive physical and mental health benefits of exercise for young people with intellectual disability. Hodge et al (2018) aimed to examine the perspectives of physical education instructors in Brazil on their practice of educating children with special needs. Adeniyi and Omigbodun (2016) goal was to find out how social skills training for students with intellectual disabilities attending a special school in Southwest Nigeria affected them. Cook and Rao (2018) focused on that secondary school instructors may create and adapt successful strategies for students with learning disabilities (LD). These children need rigorous interventions to enhance skills (such as reading comprehension and decoding) and access to grade-level material. Lee et al (2015) was to analyze the perspectives of Hong Kong's preschool instructors (N = 410). Among educators, support for inclusion is reportedly low. Inclusion of students with intellectual disability, visual, auditory, or speech and language impairments was supported more strongly by educators with special education training, regardless of their position in the school.

## 3. Materials and Methods

In the Southeast region of the United States, a student attends a suburban elementary school. The total strength of 550 preschools through fifth grade was the source of three participants. Participants had to meet certain criteria to be considered for the study, including the following: Three students, two females, and one male, met this criterion: (i) getting special education services below the state's MSID varieties; (ii) registered initially via fourth grade; (iii) being capable of openly selecting an established stimulus from a list of three or more responses within a few seconds; (iv) using symbolic language for communication purposes; (v) consistently present at school; (vi) having signed informed parental consent; and (vii) participating in a research study. Table 1 contains demographic data for each participant. These three students are designated here as A, B, and C, respectively.

*Student A:*

Student "A" performed well below average on the Children's Kaufman Assessment Battery. Scores on the Vineland Adaptable Behavior Scale for adaptable behavior were in the first percentile or the lowest possible range. "A" received a combined score of 47 reading comprehension and letter/word recognition scores on the Kaufmann Test of Educational Progress which indicates that their overall reading abilities are at a very low level. Katie was proficient in reading short passages including well-known sight words, writing personal information, and recognizing all letters and numbers up to 50. She was unable to finish mathematical puzzles and speak audibly in new situations or with new people. In the resource special education classroom, Katie received lessons in reading, arithmetic, and vocational skills.

*Student B:*

The Preschool and Primary Wechsler Scale of Intelligence results for student B were exceedingly her age-appropriate overall intellectual functioning was below average. The VABS ratings for adaptive behavior were in the 1 percentile. For Cassie, no reading test results were provided. Cassie could count to three on the Brigance Complete Assessment of Basic Skills II and would sometimes use the words "who" or "where" in her queries. The majority of alphabet letters could be said out loud by her. She needed assistance to keep on track since she couldn't say her name or recognize common colors. In the resource special education classroom, "B" got training in reading, arithmetic, and vocational skills.

*Student C:*

The scores on the KABC for Student C were very low range. According to a student with MSID, their adaptive behavior scores on the VABS were in the one percentile. Bobby didn't have any reading test results. When Bobby was administered the Bayley Scales of Infant Development, he demonstrated the ability to pay attention to visuals, make deliberate actions to get something, orient to noises, looks for missing things, picks up objects, and put them in a container. "C" took science and math courses in the general education setting with paraprofessional assistance, and acquired training in reading, arithmetic, and vocational subjects in the special education environment. Four years ago, he arrived in the country as an English language learner.

**Table 1** Details about the Participants.

| Name of the student | Age and grade | Analysis, categorization | IQ level | Behavior adaptability index | Time spent studying MSD daily | Skill ability |
|---|---|---|---|---|---|---|
| A | 9 years old, 4th grade | MSD, ELL | 48[b] | 63 | 3 | Provides spoken responses to questions testing reading comprehension by reading simple sight words or pointing to possible answers. |
| B | 7 years old, 1st grade | MD | 46[c] | 47 | 3 | Reads simple sight words, describes, or points to answers, but has trouble remembering and generalizing what they've learned. |
| C | 10 years old, 4th grade | MD, ELL | 3-year-old range of development | 48 | 4 | Shows interest in books and reading, recognizes letters and sounds, and can read some simple words |

*Other students:*

The first author was the participant's special education teacher and the study's lead investigator. She possessed a special education bachelor's degree, was enrolled in a master's program for teacher leaders in special education with an emphasis on MSID, and had worked as an MSID classroom teacher for nine years. Two undergraduate practicum students and one paraprofessional from a special education classroom data on dependability were gathered throughout the study sessions. Both individuals are knowledgeable in organized instruction and gathering data from student replies.

### *3.1. Text selections and a picture storyboard*

Ten text options that the researcher adjusted made up the materials. Each option was limited to one page and 100 words. The researcher chose sections from picture books and workbooks that had grade-level content, and then she edited them by reducing the text's length and adopting a more formal language. The options were printed on letter-sized paper in black text with no graphics and simple words. Each sentence had a number. According to the Lexile Framework for Reading, the range of the Lexile measure was from 270L to 600L, which corresponds to a first- to third grade understanding level. The collection included works of fiction and nonfiction equally. Each revised text selection included a story involving two people, allowing for in-depth comparative research. The second writer offers a comprehensive reference that includes reading levels, Lexile measures, and grade equivalencies. Each word option was accompanied by an image storyboard. On a piece of paper that measured 11 cm by 28 cm, the storyboard featured one image for each phrase of the chosen text. Using the Board Builder program, color-printed images were created for the storyboard. Under each image, a sentence with a number that matched the phrase from the text was printed in black script. As the investigator read the material aloud during research sessions, she noted the matching image on the storyboard.

### *3.2. Pictures and a visual organizer*

Training and the SLP prompting hierarchy both made use of a visual organizer (Venn diagram) to visually arrange the information. Every surface of the Venn diagram was named after characters from the chosen literature. To emphasize its

significance, the overlap region of the Venn diagram was given the color yellow. A laminated Venn diagram with Velcro fasteners was used so that images could be affixed to the diagram's edges and overlapping regions. The people and objects in each text were represented by colored illustrations that were laminated and had Velcro straps connected to the back. The visual organizer was shown on a slant board throughout each session.

*3.3. Conceptual Model and Choices for answering questions*

There were three questions for each text choice with four possible answers that requested comparisons between the text's characters. On a letter-sized sheet of paper, one question and four possible answers were put in black type. Below the question were the four possible answers. Each possible answer included a colorful image and a statement that went with it in black text. The images on the answer choices and the storyboard were identical. The right response, two logical answers, and an improbable response were the options for the answer.

*3.4. Study Design*

This research used a variety of probes across participants' designs to evaluate the performance of SLP and visual organizers as pedagogical tools for improving reading comprehension. At the start of the research, each participant got probing trials. The intervention condition began with that individual after all layers of data were stable. The intervention was time lagged between the second and third participants before it was put to use, and irregular probes were conducted at untrained levels. A therapeutic shift from the starting point until the intervention for all three topics serves as an illustration of experimental control as it only takes place when the intervention is made available.

*3.5. Data collection and dependent variables*

The percentage of accurate, independent answers to reading comprehension questions requiring students to compare characters from an altered book served as the dependent variable. Student answers were recorded on a trial-by-trial data sheet throughout each session. All participant responses were graded as either correct, incorrect, or no response. The amount of prompting used during intervention sessions that produced the right answer on each trial was recorded by the researcher. For three sessions in a row, the standard was set at 100% accurate independent responding.

*3.6. Procedures*

This research provides a comprehensive look at four distinct sorts of procedures: probing procedures, intervention procedures, maintenance procedures, and generalized procedures.

*3.6.1. Probe procedures*

All participants' probe data were gathered at the beginning of the research, and the untrained individuals' data were gathered sporadically after that. Per the probing session, each participant performed three trials, each of which consisted of questionnaires referring to various ways the characters in the text were similar. The following was the order of the probe process trials: It's time to read a narrative, the investigator said, directing the participant to the teaching space. Welcome to the table, please. To signal preparedness for teaching, the participant had to provide an attention response. We're going to create a picture as we read, the investigator said. You may use it to aid in your response to the story's concluding questions. The researcher randomly selected a section of the altered text and read it to the participant while pointing to each image that represented a different section of the tale on the storyboard. To make sure the participant was paying attention, the investigator put similar images on the Participants were provided with a Venn diagram on a slanted board. While she pointed to the storyboard. Depending on whether the image linked to one of the characters or both, each visual was either put on the left, the right, or an overlapping section of the Venn diagram. Compare and the investigator commanded after the narrative had been read. "How are they the same?" she said, displaying the choice sheet for the question and answer. The subject was given a 5-second response window and the researcher read out each possible response to them. The investigator gave repercussions in response to the participant's answer. The investigator offered generic compliments (such as "Great" and "Good job") for accurate replies. The investigator offered encouragement for attendance and focus when subjects gave wrong or no answers (example: "Good job looking at the pictures."). The following trial was then provided after a delay of one to five seconds. During the probing sessions, a total of three questions were posed.

*3.6.2. Intervention procedures*

Participants were taught to compare characters in an altered text using an SLP process by the teacher. Before each instructive session started, the teacher chose a storyboard and an adaptation of a text at random. Participants were requested to attend the lecture and demonstrate their readiness, much like in probing sessions. The investigator then gave a quick tutorial on character comparison using a sample text. During the mini-lesson, the teacher initially randomly selected a passage from a modified text before displaying the larger Venn diagram in front of the students on the slant board. The

instructor went on to explain where on the diagram the illustrations of the "same" traits would be located ("If I want to know how two characters are the same, where should I look?"). She then instructed the pupil to indicate the Venn diagram's overlapping region. The instructor then read the student's choice of the altered text while positioning related images on the Venn diagram to aid in understanding and pointing to the storyboard. The instructor waited and examined how the characters were the same before placing a graphic in the overlapped space.

Following the completion of the mini-lesson, the researcher picked a different text selection at random, read it to the student, pointed to the storyboard to aid understanding, and added relevant images to the visual organizer as she read. The instructor stopped after placing a graphic in the diagram's overlapped area and made a comparison (for example, "Tigers and lions are both huge cats.) They are similar in this way. You may use the Venn diagram we drew together to assist you to reply your questions, the investigator added after reading the participant the question and response possibilities. Put (one character) and (another character) side by side. How are they comparable? The researcher recited the statement that went with each option while pointing to each response choice. After giving the subject 5 seconds to react, the researcher went through a hierarchy of prompts that were offered as required depending on their responses, going from the least to the most support. After asking the question, the researcher gave the subject 5 seconds to think it over before responding. When a question was answered incorrectly or not at all, the investigator remarked, "Wait if you need help," gave the following prompt, and waited for a response for five seconds. This pattern persisted until the participant provided a suitable answer or the whole hierarchy of prompts had been exhausted. If the subject replied properly at any stage of the hierarchy of prompts, the researcher gave particular verbal praise (for example, "Yes, you are right! Big cats include both tigers and lions. They are similar in that way. The instructor said, "Look!" and pointed to the image that matched the right response on the Venn diagram. You made the ideal decision.

*3.6.3. Maintenance procedures*

While some participants were getting training or participating in probe sessions, the investigator administered maintenance probes to those who had met the criteria at least once every two weeks. Maintenance probes were run once a week after all three students had acquired the skill. The same processes as in probe procedures were used to perform maintenance probes.

*3.6.4. Generalization procedures*

The investigator administered a generalization probe to participants twice: once before the intervention and once after they satisfied the criteria. Except for a fresh text selection that had never been used before throughout the research, generalization probe techniques were the same as those for probe and maintenance.

*3.7. The reliability*

In every setting of the experiment, procedural fidelity checks were performed. The observer gathered information on the following investigator behaviors throughout the probe, intervention, maintenance, and generalization sessions: Materials should be ready, attention cues should be given and responses ensured, the Venn diagram should be placed on the table, participants should be told they can utilize the Venn diagram to assist the response to the questions, the passage should be read aloud, students should be encouraged to point and look at the pictures on the storyboard, a response interval of five seconds should be used, and correct responses should be given for student responses. 27% of all probe, intervention, and maintenance sessions had IOA and process fidelity data gathered. IOA and procedural fidelity have an overall dependability agreement that was 100%.

**4. Result and discussion**

The percentage of accurate independent replies for Student "A" is shown in Figure 2. In the first probe scenario, a student may choose the right answer out of four alternatives just by chance since the task needed a receptive response. With an average of 27.5% accurate independent replies, Katie chose the right answer. She had an instantaneous improvement in level at the introduction of the intervention, moving to 66% correct independent replies; nevertheless, her responding varied throughout the remainder of the condition until she attained criteria in 13 sessions.

The percentage of accurate independent replies for student “B” is shown in Figure 3. “B” exhibited reliable zero-celebrating data in the first and intermittent probing sessions but either chose the wrong answer on each trial or did not reply. Once Katie had met the requirement, she was given the intervention condition. Her proportion of independently right replies rose when the intervention was introduced, but responding was inconsistent and demonstrated a lack of development.

The percentage of accurate independent replies for student "C" is shown in Figure 4. The C had consistent and zero-celebrating data in the first and intermittent probing sessions because he either gave inaccurate or no replies throughout the response interval. The investigator worried that "B" would not go back to school and be able to finish the intervention,

therefore C's intervention started before Cassie met the criteria. She thus did not want Bobby to endure an undetermined period of no therapy. However, "B" was reacting 66% to 100% over probe levels when "C" started the intervention.

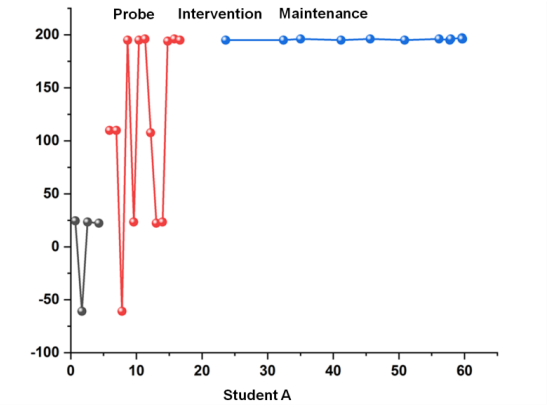


**Figure 2** The percentage of accurate independent replies for Student “A”.

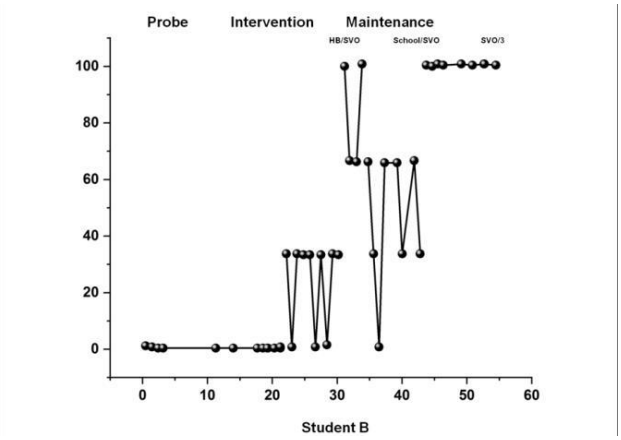


**Figure 3** The percentage of accurate independent replies for Student “B”.

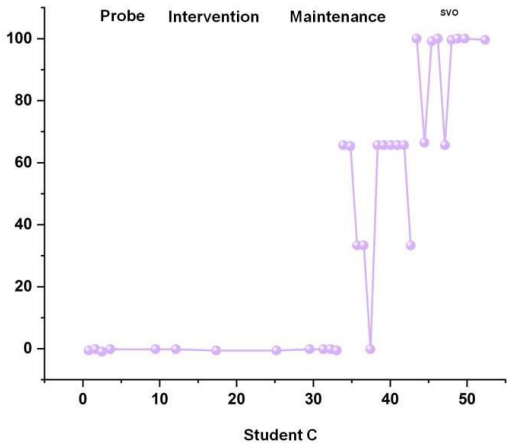


**Figure 4** The percentage of accurate independent replies for Student “C”.

*4.1. Delivered promptly levels*

Depending on how each participant responded, the teacher varied the frequency of prompts throughout the prompt hierarchy for each participant. Katie got at least one prompt from each level of the prompt hierarchy during each educational session, but she never needed the physical prompt. For her to reply appropriately, she often required a verbal cue prompt from the researcher, who informed her of the pertinent stimuli to pay attention to. For Cassie to respond correctly, she needs to see every prompt at least once. The model and vocal prompt were the prompts that were given to Cassie over most sessions and yielded a successful reaction. Bobby too needs all of the hierarchy's instructions to respond correctly. The visual and verbal cue, the model and verbal prompt, and the reminder to look at the Venn diagram and to note the similarities

between the characters were the most commonly used prompts for Bobby. Table 2 lists the quantity and percentage of cues given to participants during instructional sessions.

**Table 2** Total number and percentage of each kind of prompt used during intervention sessions.

| Educational session prompt frequency and trial percentage | | | | |
|---|---|---|---|---|
| **Students** | **Prompt given verbally** | **Prompt given verbally and visually** | **Illustration and admonition** | **physical prompt** |
| A | n =10; 25% | n = 2; 3% | n = 2; 7% | n = 0; 0% |
| B | n =11; 13% | n = 11; 12% | n = 14; 17% | n = 2; 3% |
| C | n = 5; 8% | n = 6; 13% | n = 6; 11% | n = 1; 2% |

The results demonstrate that a visual organizer used in an SLP approach was beneficial in improving the level and trend in primary pupils with MSID's ability to contrast two characters from adapted texts. The above instructions, with a few modifications, were successful for "A," "B," and "C." Children with MSID were taught how to utilize a visual organizer and respond to comparison questions of characters in the modified text, and the results showed that the SLP was successful. Of all participants, two students who modified the textual processes and one student who made no modifications met the requirements with the addition of an SLP and a visual organizer. The findings show a functional link between SLP, visual organizer presentation, and participants' capacity to respond to questions concerning character comparisons in the modified text. The abilities were retained by all three individuals. Three people (Katie, Cassie, and Bobby) were capable to transfer these abilities to a novel tale with 99% accuracy, although Bobby could only execute it with a 66% accuracy rate.

## 5. Conclusion and Implications

The research on academic content acquisition and students with MSID is furthered by the findings of this study. Through methodical training and the usage of a visual organizer, students with Mild and severe Intellectual disability were able to replicate prior academic studies in teaching by making quantifiable progress in the learning of a reading benchmark. By being the first to instruct primary pupils with MSID in the standard of character comparison, this research also advances the literature. This research does have certain limitations. Due to the time restrictions of the school year's conclusion, social relevance data were not gathered. It is impossible to assess the social validity of the objectives, methods, and results of this study, even if these processes are comparable to those used in related research. Future studies should look at the selection and use of visual organizers in the academic standards instruction of students with MSID.

## Ethical considerations

Not applicable.

## Declaration of interest

The authors declare no conflicts of interest.

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# The impact of teaching with schemas on structural word challenges

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**Abstract** Instruction is adapted for students having a specific learning disability (SLD) that focuses on the fundamental structure of maths recommending problems as an evidence-based practice. Additionally, evidence-based schema-based education is viewed as a practical strategy for students with an SLD. This study expanded upon earlier efforts by (a) utilizing the implementer and a teacher, (b) assessing a flexible intervention's efficiency, and (c) assessing the performance of students on integrated and generalized schema structure issues. There were 12 impaired fourth and fifth graders receiving extra maths teaching in a resource room. The intervention package included arithmetic education based on schema and a problem-solving mnemonic. A multiple-probe approach involving different participant a functional connection was done using groups. Students performed better when given straightforward, generic, and integrated schema structures. The aggregate normalized mean difference between cases (BC-SMD) for this study was 3.05 (CI95 [2.54, 3.60]), while aggregate "Tau-U effect size (ES) was 95% (CI90 [83%, 100%]").

**Keywords**: schema-based instruction, mathematics, problem-solving

## 1. Introduction

The Common Core Standards strongly emphasize the value of solving structural word challenges following the structural word challenges. Investigating more effective teaching methods, such as modelling and schema-based instruction, is essential since general structural training has yet to successfully educate pupils with learning difficulties or those at risk of developing them. Understanding the requirements of children with difficulty solving mathematical problems is crucial before choosing and assessing educational solutions (Hughes 2020). Student's today need different preparation compared to pupils in past, they must be more prepared for workforce actively participate in their education to be ready for life after the classroom. Graduates must be prepared to enter the workforce with the communication, teamwork, problem-solving, analysing, and application abilities required by the workplace (Skinner and Cuevas 2023). Schema matching, which looks for semantic similarities between elements of two schemata, is a crucial step in data integration. Experts with a solid grasp of the data's semantics have traditionally handled this task. However, as current schemata grow in size and complexity, manual schema matching becomes time-consuming and error-prone (Hättasch et al 2022). Large-scale self-paced online courses typically do not require an instructor to be available at all times. Due to the lack of personal interactions and adequate procedures for reliable learning assessments, learners find it difficult to gain in-depth knowledge and skills in many learning contexts, particularly in self-paced online environments (Jung et al 2022). Despite the various instructional strategies developed children struggle to answer challenging problems, despite efforts throughout the world to improve children' arithmetic skills employing a wealth of procedural and conceptual information. Students have reportedly had trouble comprehending algebraic expressions and equations, a comprehension of dynamic role of variables, use of constants and coefficients to isolate unknowns, and use of algebraic knowledge to solve issues in context (Adeniji and Baker 2023). Both elementary mathematical topics and high school topics like derivatives have linguistic difficulties when it comes to word problems. According to one research, students had trouble understanding language, knowing what information to utilize, or comprehending the text when completing derivative word problems (Fatmanissa et al 2020).

## 2. Literature Review

The paper Arsenault and Powell (2022) performed on word problems in terms of schemas and position of the unknown, then we evaluated how well kids with Mathematics Difficulty (MD) performed in terms of schemas, role of the unknown, irrelevant information, and charts or graphs. The paper Alghamdi et al (2020) looked into the efficacy of teaching third- and fifth-grade students with arithmetic difficulties to solve multiplicative whole-number word problems using

Schema-Based Instruction (SBI), a research-based intervention. The paper Ovadiya (2023) was utilized as a foundation for instructing high school students with difficulty with mathematics (in a regular-level mathematics classroom) and may provide a framework for task design to promote a problem-solving, thinking classroom. The paper Khatin-Zadeh et al (2023) examined the effects of priming a metaphor through the gestural portrayal of its schema on metaphor interpretation. The paper Vidanaralage et al (2022) investigated participant behaviour when interacting with the flipped learning environment, medium of instruction, and video-based learning resources. The paper Powell et al (2022) focused on the Data-based Individualization (DBI) framework used in a tier-based support system for maths intervention paradigm as children having problems with math. The paper Peltier et al (2020) expanded upon earlier efforts by (a) utilizing the practitioner as a teacher, (b) assessing the effectiveness of a flexible intervention, and (c) assessing the performance of students on integrated and generalized schema structure issues. The paper Polo et al (2021) employed multiple baselines across students' design, looked at three students, two of whom had autism spectrum condition, had modest intellectual difficulties—performed at solving mathematical word problems. The paper Fuchs et al (2022) evaluated the impact of Word Problem (WP) intervention with embedded Language Comprehension (LC) education on those on the WP performance of at-risk first graders. The paper Corral et al (2020) investigated the effects of giving people schema training at the beginning of learning (relative to later stages) on mathematics word problems modelled after problems from the Graduate Record Examination. The paper evaluated an evidence-based classification of Schema-based Instruction (SBI) as an intervention to improve word problem-solving outcomes for students with learning or math problems in Grades K–12. The paper Cox and Root (2020) evaluated the efficacy of Modified Schema-based Instruction (MSBI) on the development and upkeep of social skills in middle school students with Autism Spectrum Disorder (ASD) arithmetic material also practices. The paper Fuchs et al (2020) suggested a contribution of language understanding to Word-Problem Solving (WPS) is given, along with an explanation role of language comprehension in WPS. The paper Peltier et al (2021) diagnosed with a specific learning disability (SLD) struggle to solve mathematical problems. One potential strategy for children with SLDs is Schema-based Instruction (SBI).

### *2.1. Current Study*

By assessing (a) the impact of connected, basic, and simple schema architectures on word problems; (b) the instructor acting as implementer; (c) the viability of a modified intervention technique; and (d) participants' social acceptability, we hoped to further enhance the literature. The following inquiries guided our research (Table 1):

**Table 1** Characteristics of Participants.

| Name | Age/grade | ALL | Ethnicity | Primary disability | Secondary | IQ | Math achievement |
|---|---|---|---|---|---|---|---|
| Asher | —/4th | — | — | — | — | — | — |
| Drake | 10/4th | No | Black, Asian, White | SLD | SLI | 83 (WISC-V) | 87 (KTEA-III Brief) |
| Andy | 10/4th | No | White | OHI | SLI | 78 (WISC-III) | 88 (KTEA-III Brief) |
| Joe | —/5th | — | — | — | — | — | — |
| Jack | 11/5th | Yes | Hispanic | ASD | SLI | 83 (WISC-V) | 77 (KTEA-III Brief) |
| Javon | 11/5th | No | White | ASD | None | None | 78 (KTEA-III Brief) |

**Research Question 1:** Exists a relationship between a more significant mean-level shift and SBI in correctly solving word problems in mathematics using basic “schema structures”?

**Research Question 2:** How does SBI impact students' use of combined and generalized schema structures when solving word problems?

**Research Question 3:** What is the intervention's social acceptability to students and teachers?

## 3. Methodology

### *3.1. Participants*

Twelve students in all took part in the research (Table 1). Each student's Individualized Education Program (IEP) required a math-related annual objective, and math general education classroom instruction combined with unique education support settings was needed to be included in our study. According to all participants met with the special education teacher, these requirements. Every interventionist was the special educator. She was a conventional certified teacher with more than dealt with students with unique needs for 20 years. Getting a master's in special education. Dealt with SBI before. She has 13 pupils on her caseload to serve.

### *3.2. Setting*

A public education system in a state's southwest suburb served as the study's setting. Prekindergarten through fifth graders (n = 481) attended the elementary school. White (57.5%) made up the bulk of the registered students, followed by

American Indian (7%), “Hispanic (17.7%), students of two or more races (14%), and Black (3.8%)”. Economically disadvantaged students made up around 50.5% of the total student population. 8.1% of the students were English language learners, and 16.7% needed exceptional education support. In a resource room, research was conducted. The instructor handled students in fourth and five grades. A wide rectangular table and two kidney-shaped tables were in the classroom. Students in general education settings got instruction that aligned with Everyday Mathematics. The students' resource room finished assignments given by an available education teacher or received a refresher on ideas they had yet to learn during general education lessons. The class always included six to ten students, a paraprofessional, and an undergraduate particular education intern while teaching, as given during the research.

*3.3. Measures*

The current project, they developed nine metrics. One three-word problem was included in each baseline probe's schema structure. The PPW, modify, and comparison probes all had an identical format, each with three-word problems that matched the goal schema. Each problem's missing value was assigned at random. Each search had three-word problems that matched the goal schema, known as generalized PPW, change, and comparison probes. The intervention and maintenance phases both used merged schema probes. Each test had three-word problems. Every syllable puzzle has several steps and two different embedded schema kinds. One problem per schema structure, mixed schemas were only utilized during maintenance and had the same format as baseline probes. The special educator stated the targeted skill area for measurements. Fourth-graders made comprised groups 1 and 2. Calculation was only allowed for double-digit whole numbers for these groupings that did not need to be regrouped. Fifth-grade kids made up Group 3. Only fractions with the same denominator could be calculated.

*3.4. Measurement and Experimental Design*

The effectiveness of an intervention program that combined SBI with a mnemonic for problem-solving and student performance on mathematical problem-solving using a multi-probe design involving different student groups. This particular design was chosen because (a) Target behaviour could a reversed, and (b) an instrument structure enabled do away with the lengthier standard assignments for Groups 2 and 3. Every WWC Pilot Single-Case Design Standards (2017) were consulted when designing the study to ensure that it adhered to particular requirements for Multiple-probe designs: (a) At the start of the study, three panels simultaneously collected baseline probes and right before intervention was introduced, and (b) a data point as collected when intervention first came up in one panel and across all succeeding panels. Because the teacher preferred to start with the smallest group, Group 1 entered intervention first. Three of four children in Group 2 had a stable baseline when intervention began, but only two of six students in Group 3 had a stable baseline at the time of decision. This difference allowed Group 2 to commence intervention before Group 3.

The ability to solve mathematical puzzles was the dependent variable. Students were awarded points for accurately completing each stage of a mathematical problem to gauge their progress. The following method converted this value to a percentage: $(earned\ points\ /\ possible\ points) \times 100$. The process involved (a) designing an appropriate schematic diagram (s), (b) inserting quantities in the suitable locations inside schematic diagram(s), (c) creating a precise to facilitate a solution, and (d) offering appropriate answers. Every issue carried a 4-point value. Students had to finish twice, earning 8 points when using combined schemas.

*3.5. Interobserver Agreement (IOA) and Implementation Fidelity*

A doctorate student in a program for special education that is also a “Board Certified Behaviour Analyst (BCBA)," an additional judge for permanent goods for evaluation of IOA. For scoring baseline and intervention probes, the first author offered two training sessions lasting 30 minutes each. 90% agreement on two successive investigations was the threshold to be met before being allowed to leave the course. Every baseline, intervention, and maintenance probe had IOA data collected. IOA was 96.5% for intervention/maintenance and 96% for intergroup comparison.

In a program for special education, two doctorate students assessed implementation faithfulness. The teacher's training session and a second 30-minute session on the fidelity checklist were both attended by evaluators. The fidelity of implementation data was gathered throughout the study in 33% of intervention sessions. Fidelity was 96.7% (variations among groups: 96.5%–96.9%). Each fidelity check included gathering duration. The timer started following stating behavioural expectations also beginning first problem model. After modelling was finished and before the session's probe sheet was created, the timer was stopped. Sessions lasted an average of 18 minutes (from 16 minutes for Group 1 to 20 minutes for Group 3). Combination schemas had an average runtime of slightly more than 25 minutes.

*3.6. Procedures*

*3.6.1. Baseline*

The specialist educator had 30- to 40-year teaching career minutes daily during baseline. There was no set curriculum in place, and frequently, students brought completed worksheets to a general education teacher. The instructor summoned the group to kidney-shaped table at room's back for data collection periods and handed them the appropriate sheet for probing. All word puzzles were read out by the teacher, who also provided a calculator.

*3.6.2. Teacher training*

The intervention was taught for three hours by the first author. The aim based a strategy on a heuristic for solving problems and SBI on boosting students' performance was explained at the beginning of the training. Four steps comprised a problem-solving heuristic: Look into the issue, create a schematic diagram of the problem, Identify the subject, and Review the STAR for the solution. Four steps for effective issue solving are aligned with STAR: Recognise, Plan, Solve, and Reflect. A schema for each was explained, along with the matching diagram of a schematic. The teacher then had an opportunity to classify and record issues that matched the intended schemas. Before letting the trainer's model of teaching, an issue that fits each structure modelled one problem for each schema. The trainer went over each item on the fidelity checklist with the teacher. The binder containing all about intervention materials was given to the instructor at the end of training. The research team swiftly debriefed on any missed steps after giving the teacher the completed fidelity checklist during direct observations.

*3.6.3. Intervention*

There were 19 intervention sessions overall for each group. The following sessions were part of the intervention: two schema identification sessions and four PPW sessions, four sessions about compare, four sessions at change, three sessions on coupled schemas, and two sessions on combined schema identification. The teaching sequence was created using explicit instruction principles. The teacher would call a limited number of people to a kidney-shaped table in room to begin each session. The teacher started the lecture by reviewing behavioural expectations, restating the goal of becoming a problem solver and outlining the day's aim following the framework for Audience Behaviour Conditions. Depending on the logistical limitations and the intervention order, the teacher modelled between one and three difficulties.

The teacher explained the goal, its reason, and behavioural expectations, reaffirmed a plan, and asked for student input during closure in the schema identification sessions (n = 4). Only first two steps—identifying crucial information and structure of problem—were practiced during modelling and guided practice, though. Students sorted around ten issues into the appropriate systems to conclude the lesson. In combining structures, students recognized two structures included into each case.

*3.6.4. Maintenance*

The special educator provided formal training to participants for 15 to 30 minutes during maintenance. The teacher gave no problem-solving instruction. Groups 1 (2-3, 14-15, 23-24 instructional days), 2 (5-6, 14-15 instructional days), and 3 (7-8 instructional days) all received maintenance probes at various points after the intervention. The baseline and probe techniques were the same.

*3.7. Data Analysis Techniques*

To ascertain (a) whether a functional relationship and (b) the size of an effect, used visual analysis. Six essential characteristics of data level, trend, variability, immediacy, overlap, and consistency guided decision-making. They followed the procedures outlined 2017 WWC Design Standards to systematize this strategy: Identify any concerns and observe whether reliable data were acquired by (a) analysing the baseline; (b) evaluating each phase's level, trend, and variability independently; (c) examining cross-phase comparisons for overlapping, promptness, and consistency; and (d) determining whether examples of the same phenomenon were seen at three different times.

The BC-SMD measures the degree of change from baseline to intervention, essentially the same as group design metrics. We submitted the modified BC-SMD for the current project, which makes use of it because it provides additional flexibility, Restricted Maximum Likelihood (REML). The results of the visual analysis helped us make the selection of the model. They specified baseline-level trends since fixed effects were absent in most cases because baseline levels were frequently varied because baseline values were consistent across instances and randomly. They chose a steady trend intervention since simplest model and offered the best match. An adjustment in level between intervention and baseline, which varied between cases, led to the specification of a random and fixed intervention effect.

Students responded to a social validity survey, an initial maintenance probe for their group. With emoticons to symbolize the varied levels of satisfaction with the intervention, responses to questions ranging from strongly disagree (1) to strongly agree (5). Students could express their likes and dislikes of the intervention by responding to two open-ended questions. The teacher answered the 21 items on a 7-point Likert scale plus the five open-ended questions that made up the

Treatment Acceptability Rating. Three latent variables' measurement characteristics (a) Appropriateness, (b) Perceived advantage, and (c) convenience supported by research.

## 4. Result and Discussion

This study examined 12 children with impairments getting more arithmetic education in a resource room. It involved in analysis, which looked at the association between schema education and mathematical problem-solving ability. Figure 1 displays the results for each participant as graphs. Although the effect size varied across cases, overall visual analysis showed a functional relationship between schema training and mathematical problem-solving performance for all participants. Below is a more detailed account of the conclusions from the graphical study. The combined "Tau-U ES was 95% (CI90 [83%, 100%])", indicating that 95% of intervention data were better after correction than baseline. Standardized units increased it by 3.05 from the baseline to intervention, with an aggregated BC-SMD of 3.05 (CI95 [2.54, 3.60]).

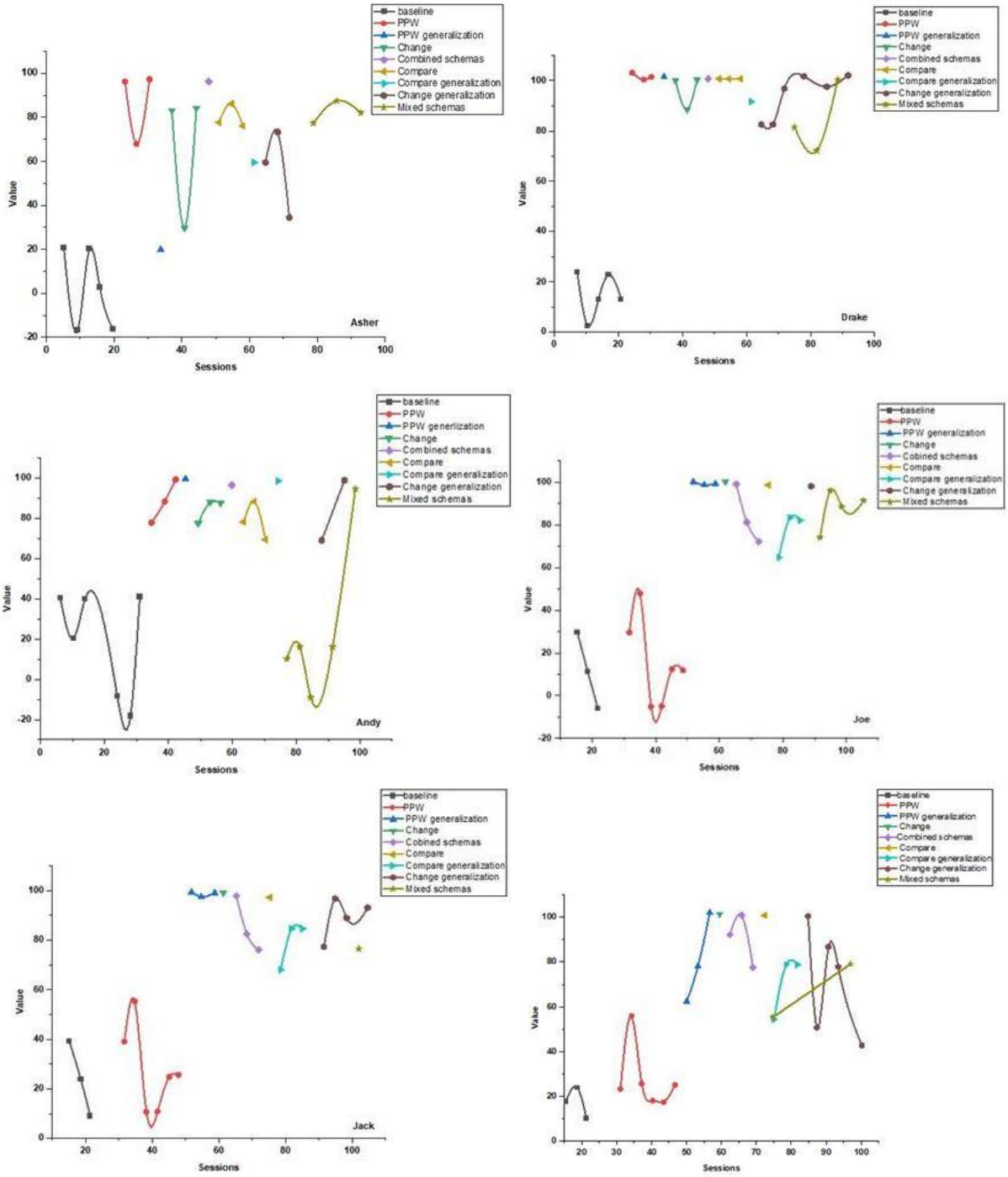


**Figure 1** performance at solving problems in mathematics.

*4.1. Group 1*

The mean values 16.8% and 26.7%, respectively, for Asher's and Drake's baseline. Drake's baseline fluctuated less than Asher's, oscillating between 0% and 33%, and finished on a decreasing trend baseline showed only minor variability, varying between 16.7% and 33%. Asher's intervention data needed to be more consistent. With the exception of coupled schema, Asher was successful with at least two probes during each problem structure. Asher fared worse than simple structures for PPW and modified generalized systems but better than simple structures for comparing generalized searches. All of Drake's intervention data, including generalized structures, except for coupled schemas, had a 90% stability rate or higher. For both students, the immediacy of effect was significant when comparing across stages. For Asher and Drake, baseline and intervention, there was a mean-level difference of 60% and 69.6%, respectively. During an intervention, both students fared worse against main structure probes on mixed schema probes for maintenance data.

*4.2. Group 2*

The baseline mean level is below acceptable values: 31.9% (Andy). The results showed that baseline data across cases varied greatly: 16.7% to 50% (Andy) and 0% to 50%. Before the intervention, Mike and Andy's statistics showed a tiny upward trend.

Students' performance effectiveness of mixed schema probes during the intervention and their function on specific structures were comparable for maintenance data. Four pupils each received a perfect score on the examination 14 days after teaching. Students achieved or exceeded their performance during the intervention regarding combination structures. Fifteen days after education, all four pupils received 95% or better grades.

*4.3. Group 3*

The average baseline level in all cases was 18.5% (Joe), below permissible ranges. All subjects, except for Jack, that offered a consistent baseline, showed variation: 0% to 50% (Joe). Ellie, Gabe, and Javon all produced varying baselines. However, Joe's was variable to steady. For this group, intervention data were inconsistent. Except for Joe on change, in each simple structure, every student met criteria of 80% at least once. All students achieved scores equal to or higher than their simple structure performance on generalized issue structures. Only Joe and Javon had completed the 80% requirement for combination structures. Four of the pupils had a significant immediate effect when comparing across stages. On mixed schema probes, students still needed to meet the need for maintenance data. Six pupils received composite schema probe scores ranging from 75% for four to 66% and 33% for the remaining two. Five out of six students performed better on combined schema structures than during the intervention.

*4.4. Social validity*

The exercise received a passing rating from a teacher, an advantage, and convenience. That pupil used schematics drawings to enhance their capacity for solving mathematical puzzles. Using a word problem mnemonic for addressing issues and schematics for understanding organized information were two aspects of intervention she found most helpful. Given their similarity, the teacher advised changing the compare and change diagrams. Thanks to this adjustment, students may find it easier to differentiate between them. During the implementation, she found two problems. Due to school-wide events and the need to pull pupils from several maths classrooms, scheduling was first a problem.

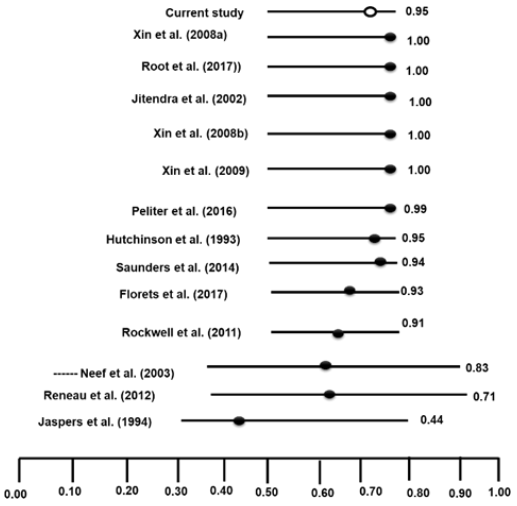


**Figure 2** Schema-based instruction forest plot of single-case experimental designs.

## 5. Discussion

The purpose of this study was to find out if SBI enhanced students' problem-solving skills, when dealing with word problems that included simple, generalized, and mixed schema structures. Another goal is to evaluate the effectiveness of teachers applying for intervention given the logistical limitations of the learning environment. Looking at EBPs used by teachers in realistic settings and circumstances, the nasty detail must be addressed to close the research-to-practice gap. Additionally, they must discover strategies to improve kids' performance on more complicated problems when assisting students with disabilities required for success in general education mathematics courses through problem-solving exercises.

## 6. Conclusions

Most students reacted favourably to schema instruction and were competent at resolving combined and generalized problem structures. Prior studies assessed student performance on generalized issue structures without teaching, and the results showed that pupils needed to generalize. The present investigation showed that students' performance was comparable to simple structures after instruction in these generalized structures. Only a few studies have examined students' composite schematic structure performance. Most students' performance was similar to basic structures. Specific training with issue structures can give students access to problem-solving abilities to navigate a general education setting more quickly.

## Ethical considerations

Not applicable.

## Declaration of interest

The authors declare no conflicts of interest.

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Understanding intellectually disabled students' participation and impact in school extracurricular activities

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**Abstract** The commitment of secondary-aged children with intellectual disabilities in school sponsor Extracurricular Activities (ECA) was examined in connection to score intensity, support requirements, and usage of augmentative and alternative communication (AAC). Participants are special education instructors with a minimum of one intellectually disabled student on their attention who took part in an organised ECA at their school (N = 498). A nationwide listserv for transitioning professions' participants was issued an online survey to gather data. Teachers indicated that students engaged in a variety of ECA in performances, school groups, unique events, and sports/fitness. The overwhelming common of students took part in activities for little more than three hours each week, and they did not take part in events that were exclusive to students with impairments. The kind of extracurricular events students participated in, how much time they spent participating each week, and how much they participated in ECA to facilitate was exclusive to students with disabilities all had an impact on their maintain needs and utilize of AAC. Except for events that solely included kids with impairments, grade-level disparities were not significant.

**Keywords**: intellectual disability, augmentative, ECA, alternative communication, secondary age

## 1. Introduction

The instruction of pupils who have an intellectual disability. Historically, these pupils were often excluded from regular classrooms and received a condensed curriculum that was mainly concerned with functional abilities. A more inclusive and rights-based strategy, however, has developed to deliver excellent instruction and encourage the full involvement of children with intellectual impairments in mainstream schools and society. This paradigm shift's trend towards inclusive education is among its most important features. The idea of inclusive education promotes integrating children with intellectual disabilities into regular classrooms as far as is practicable. This transformation is brought about by the notion that every student, regardless of aptitude, has a right to attend and participate in mainstream education (Siperstein et al 2019). The International Classification of Functioning (ICF) involvement is regarded as a crucial area to comprehend and treat the health and well-being of youngsters. The “World Health Organisation” (WHO) developed the ICF, a system that provides a uniform language and framework for describing health and states pertinent to health. It recognises to facilitate physical condition encompasses more than just the absence of illness and encompasses a larger concept of functionality and well-being. The emphasis on participation in paediatric health care research and practice acknowledges that a child's capacity to actively engage in daily life is essential for their overall development and well-being. It emphasises the overall effects of health issues on children's lives in addition to just diagnosing and resolving impairments or functional limits (Liao et al 2019). ECA at academic research institutions. Activities that students choose to participate in on their own time and outside of their normal academic courses are referred to as extracurricular. Sports, clubs, student organisations, volunteer work, leadership positions, internships, and several other types of participation are examples of these activities.

According to some study, taking part in ECAs may enhance academic success. Students may improve their organisational skills, multitasking abilities, and time management skills by participating in ECA, which might lead to higher academic results (Eizaguirre et al 2019). Individuals choose, organise, and engage in leisure activities during their spare time. They are delightful optional activities. In general, people engage in these activities for their pleasure, leisure, entertainment, or personal growth; they are unrelated to their jobs, commitments, or duties. Recreational pursuits are crucial for fostering happiness, reducing stress, and achieving a general sense of fulfilment in life. They provide chances for unwinding, self-expression, creativity, and fulfilment on a personal level. Participating in leisure pursuits may also support a good work-life balance and improve one's mental and physical health. To maintain a healthy lifestyle, people should prioritise and schedule

time for leisure activities. Individuals may improve their quality of life and enjoy and get fulfilment from their free time by purposefully selecting and partaking in activities that offer them pleasure and fulfilment (Kaljača et al 2019). Observed Disparities Students with disabilities may be singled out for bullying due to their perceived differences from their classmates, including their unique physical, sensory, cognitive, or behavioural traits. Bullying may occur as a result of a person's ignorance, bias, or intolerance of these differences. It's important to remember that bullying victimisation may have serious negative effects on disabled kids' well-being and academic progress. They may experience higher levels of anxiety, despair, poor self-esteem, academic disengagement, and other mental health issues as a result. Dedication to developing an inclusive and tolerant school culture that values diversity encourages empathy and builds a feeling of belonging for all students is necessary for efforts to address bullying victimisation of children with disabilities (Bills 2020). A learning environment's general student characteristics might in fact have both good and negative effects. The entire learning environment, academic achievement, social dynamics, and the educational experiences of the students may all be impacted by these traits. Various points of view learning environments may be improved when students have a variety of experiences, cultures, and backgrounds. Deeper debates, critical thinking, and a greater comprehension of a range of topics may be sparked by contrasting viewpoints and concepts. Opportunities for teamwork in learning Collaborative learning may be promoted by mixing learners with various talents and characteristics. Students may collaborate on group projects that encourage collaboration and teamwork while also benefiting from one another's knowledge and assistance (Bagi 2021). The creation of the Higher Education Authority (HEA) Fund for Students with Disabilities is a noteworthy milestone in this field. With the help of this fund, students with disabilities—including those who have intellectual disabilities—can enter higher education and take part in its activities. It offers financial aid to qualified students, allowing them to get the resources and accommodations they need to thrive in school. Additionally, several Irish higher education institutions have started inclusive education initiatives created especially for individuals with intellectual impairments. These programmes provide a variety of services and support that are catered to the unique requirements of the pupils. The objective is to provide a welcoming and encouraging learning atmosphere where students may gain academic knowledge, practical experience, and possibilities for personal growth (Corby et al 2020). Individuals with disabilities, marginalised groups, and members of democratic societies are just a few of the people for whom the notion of participation is acknowledged as a crucial objective. Taking part in social, political, economic, and cultural activities within one's community and in society at large is referred to as participation. It includes the capacity to participate in decisions that have an impact on one's life as well as the right to do so. It also includes the chance to participate in and make contributions to a variety of societal elements. The idea of participation is intimately tied to the concepts of inclusion and equal rights for groups like people with disabilities. Assuring equitable participation possibilities for persons with disabilities in all spheres of life—including work, leisure, and civic engagement—is the main objective. Eliminating obstacles that limit their full and active participation, both physical and psychological (Samuels et al 2020). Self-awareness Understanding oneself, including one's strengths, shortcomings, values, and aspirations, is the first step in practicing self-advocacy. It entails fostering a feeling of identity and self-assurance, which forms the basis for successfully defending one's wants and rights. Assertiveness: Being assertive entails speaking with clarity, respect, and assurance. It entails the capacity to express one's ideas, beliefs, and aspirations clearly and forcefully. Effectively defending one's rights and demands requires assertive communication. Information and knowledge Self-advocacy call on people to learn as much as they can about their alternatives, resources, and legal rights. Understanding the rules, regulations, and practices that affect their daily life is part of this.

Well-informed people are better able to make wise judgments and successfully speak out for themselves (Smith et al 2022). Society and Economy Children from privileged homes often have access to more money, which may open up options for them like attending a good school, getting tutoring, participating in ECA, and receiving educational materials. Additionally, they could have access to better nutrition, healthcare, and family surroundings, all of which might help them achieve better academic results. The level of education Schools in privileged neighbourhoods often has superior facilities, greater resources, experienced faculty, and lower-class numbers. These elements help to improve the quality of instruction and the learning opportunities available to pupils. On the other side, underprivileged schools may struggle with issues including insufficient financing, few resources, greater student-teacher ratios, and a shortage of competent instructors, which may result in worse educational performance (Behtoui 2019). Like their classmates who are usually developing, kids with intellectual disabilities may benefit from involvement in extracurricular activities at school. There are a number of factors to take into account in order to comprehend their participation and the possible influence, albeit their degree of engagement and impact may vary depending on individual talents.

## 2. Literature Review

McGarty et al (2021) investigated the parents of children with intellectual impairments were asked about their experiences encouraging physical exercise. Eight parents of kids and teenagers with intellectual impairments participated in informal interviews. 9 subthemes were divided into four main themes. Parents' attitudes toward physical exercise were generally favourable. However, there are several obstacles that parents must overcome to encourage physical exercise in their kids with intellectual challenges. High levels of stigma and isolation experienced by parents have a detrimental impact

on how they encourage physical exercise for their kids with intellectual disability. Bruno et al (2022) describes children with intellectual and developmental impairments place a high priority on quality participation, which is defined as pleasant and joyful activity. Three search engines were used to gather data using a well-established systematic scoping review approach. The requirement was satisfied by a total of 35 articles. Six experience components were used to group the quality involvement techniques (30 in total) and outcomes (8 in total). The research's results provide a fresh perspective on how to create top-notch experiences for both ongoing and upcoming participation programs. Snipstad (2020) evaluated every kid the chance to contribute to and benefit from companionship at school is a key component of inclusion. However, certain specific groups of children are more level to separation and elimination than others. Will, a youngster identified as intellectually challenged who spends most of his school days apart from his classmates, serves as the basis for the empirical data used in this article. He has created a world of made-up friends and assumed identities (roles) in this segregated setting, which he often engages in and joins. If this is the case, the instructive system must reflect on the kind of individuals it wants to create at every level—from policy to practice. Jacobs et al (2021) determined the emphasis of the present research is on untimely transition experiences, including working-class school years, while adulthood is still a less studied period in the lives of individuals with intellectual impairments. The transition experiences of six persons with severe intellectual impairments are examined in this paper, including leaving the family home and going from school to adult services. To make it easier for individuals with severe intellectual impairments to participate in decision-making processes, the need to rethink participation from a relational and interdependent viewpoint is emphasized. Reis et al (2021) investigate the effects of play and physical education activities on the social conduct of children with modest intellectual disabilities in the classroom. The pre-test, post-test, and post-test-retention control group model and the general screening mode served as the foundation for the quantitative research techniques applied. The School Social Behaviour Scale was used to assess school social behaviour. To gather information from these scales when applied to participants, physical education and play classes were given for two hours each week for 24 weeks. Children with modest intellectual disabilities who participated in physical education and playing activities for 24 weeks showed improvements in their social conduct at school (Jacobs et al 2021).

## 3. Methodology

This research is a component of a bigger investigation on kids with intellectual disabilities and school-sponsored ECA.

### *3.1. Data Collection*

The Zarrow Centre for Learning Enhancement listserv subscribers received a correspondence outlining the revision and the prerequisites for contribution. The email included a link that participants were required to click on to participate in the research. The connection led to a permission form that was published on Inspection Monkey, describing participant privileges and attesting to facilitate the research had received Institutional Review Board (IRB) clearance. Ahead of the first page of the questionnaire were those who accepted to participate. The opportunity to join an accidental sketch for 1 of 5 US$20 gift cards was provided to the participant after the assessment. No personally identifying information was gathered to protect participants' privacy, and the questionnaire's answers were not associated with those of contestants who registered for the drawing. The listserv members got a follow-up email to promote involvement a week after the original email was sent. A month passed with the link to the survey still active.

### *3.2. Data Analysis*

The arithmetic bundle for Social Sciences was used to import the records that were obtained from Survey Monkey. For the characteristics of the teachers, students, time used up participating in ECA, and the frequency of actions with disabilities, descriptive statistics were computed. Data were reorganised into several independent and dependent variables before further analysis. Due to the similarities in support requirements amongst students with severe and profound impairments, maintenance needs were condensed into 3 categories. Because the kind of AAC use was unrelated to the study issues, it was divided into two categories: "users" and "non-users." Time used up participating in ECA was recorded as "less than 3 hr" and "3 or more hr" since the researchers believed that engagement that lasted more than three hours was likely spread over numerous school days. The last category for the number of activities that exclusively consist of students with disabilities is "no activities" or "one or more activities," since attendance was the main topic of the investigation difficulty. A content analysis approach was used to classify the names of ECA. The codes and codebook were created by one researcher, and their applicability was evaluated and validated by a second researcher. A search of the Internet was used to determine the implication of activity names when the researchers were unfamiliar with them and the participants had not provided definitions. The research eliminated the names of activities that did not fall within the criteria of school-sponsored ECA. 63 activity codes in all were found. A graduate student who was not acquainted with the research was requested to utilise the codebooks to separately allocate codes to each of the ECA mentioned by the participant to guarantee that activities were correctly classified. Interrater reliability was determined to be 97.46% (807/828 activities). Discrepancies were examined and

determined to be the result of mistakes rather than discrepancies in judgment. The two scholars collaborate to classify the codes into five groups once they had been finalised.

## 4. Results

### *4.1. Time Spent on ECA*

The amount of time spent in ECA provided by the school varied greatly. 15.56% (n = 75) of students report taking part in ECA for less than one hour, 29.87% (n = 143) for one to two hours, 23.13% (n = 113) for three to four hours, and 21.95% (n = 101) for more than four hours during an ordinary week. Additionally, 10.79% (n = 52) of the pupils participating in ECA.

### *4.2. Disabled Student Activities*

The mainstream of respondents (n = 315, 64.85%) said their kids did not take part in any extracurricular events sponsored by the school and were limited to students with disabilities. A little over a quarter of the students (n = 134, or 27.35%) were reported to take part in one ECA that was open only to those with disabilities, and a much smaller proportion (n = 43, or 8.78%) were reported to take part in two or more such activities.

### *4.3. Student Overview and ECA*

Table 1 and figure 1, 2, and 3 depicts the distinctiveness of intellectually disabled kids who engaged in both categories of school-sponsored ECA. "The best part of kids (range = 63.55%-79.95%), independent of grade level, assistance requirements, or usage of AAC, was reported to engage in sports or exercise. Furthermore, according to the respondents, the mainstream of students with severe impairments (66.18%) and AAC users (63.55%) took part in school groups". One single student characteristic—namely, the absence of any post-high school students who were recognised as participating in performing arts—was the only one that was not linked to involvement in a specific kind of ECA. The involvement of kids in performing arts, school groups, special events, and athletics did not vary significantly by grade level. The relationship between both maintenance needs and involvement in school clubs differed significantly in terms of support requirements.

**Table 1** Student Characteristics and ECA.

| | Type of Activity | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Special events | | | Performing arts | | | Sports/Fitness | | | School clubs | | |
| Characteristic | n | % | $V^2$ | n | % | $V^2$ | n | % | $V^2$ | n | % | $V^2$ |
| Support needs | 3.98 | | 7.55* | | | 1.09 | | | 3.98 | | | |
| Mild (n=147) | | 7.88 | | 17 | 11.98 | | 101 | 69.5 | | 51 | 101 | 70 |
| Moderate (n=135) | | 14.6 | | 18 | 8.95 | | 161 | 75.3 | | 77 | 161 | 75 |
| Severe (n=135) | | 17.6 | | 12 | 9.28 | | 89 | 66.2 | | 69 | 89 | 66 |
| Use of AAC | 5.33* | | 6.45** | | | 2.31 | | | 5.33* | | | |
| User (n=113) | | 19.8 | | 7 | 6.36 | | 71 | 63.6 | | 59 | 71 | 64 |
| Nonuser (n=38) | | 11.5 | | 39 | 10.15 | | 278 | 72.7 | | 135 | 278 | 73 |
| Grade Level | 1.58 | | —[a] | | | —[a] | | | 1.58 | | | |
| Middle school (n=115) | | 11.5 | | 13 | 11.53 | | 79 | 69.4 | | 42 | 79 | 69 |
| High school (n=334) | | 12.8 | | 33 | 10.6 | | 235 | 71 | | 135 | 235 | 71 |
| Post-high The school (n=39) | | 8.91 | | 0 | 0 | | 32 | 80 | | 16 | 32 | 80 |

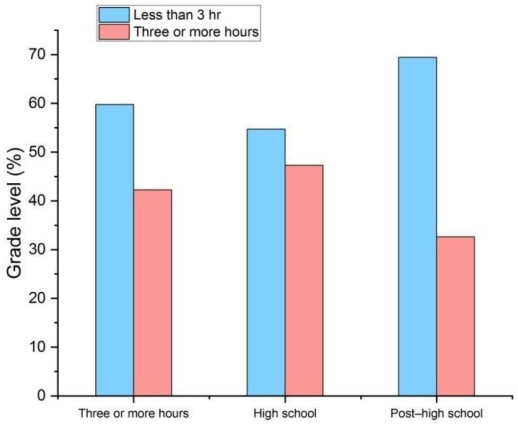


**Figure 1** Comparison of Grade Level.

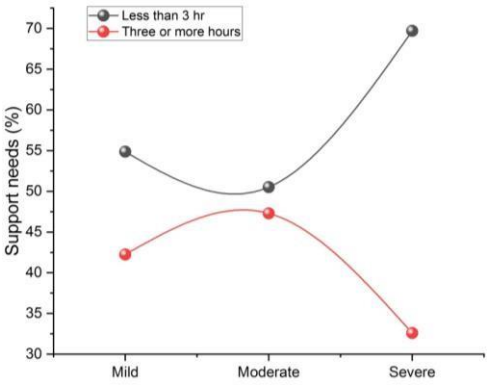


**Figure 2** Comparison of support needs.

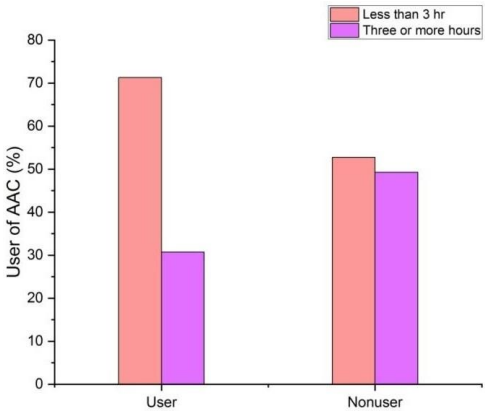


**Figure 3** Comparison of AAC.

*4.4. Characteristics and ECA*

Students can decide to take part in ECA that is relevant to their hobbies or interests outside of the classroom. For instance, a kid with an interest in music may join the school chorus or band, which would take a lot of time. To develop their talents, strengthen their portfolios, or pursue personal ambitions, highly motivated and ambitious students may deliberately seek out ECA. These kids are more likely to invest a significant amount of time in ECA. If ECA is prioritized, students may devote more time to them, even if it means sacrificing other aspects of their life. The ability to manage one's time well is essential for juggling academic, extracurricular, and personal obligations.

The duration of time children reported participating in ECA offered by their school did not vary significantly by grade level describes in Table 2 and Figures 4, 5, and 6. There were significant variations for maintain requirements $X^2$ (2, $N$ = 483) = 12.41, $p$ =.02, $V$ =.162). Students with moderate impairments were substantially more likely to engage in ECA for 3 or more hours per week than individuals with severe disabilities $X^2$ (2, $N$ = 349) = 12.063, $p$ =.01, φ =.189; $X^2$(2, $N$ = 274) = 6.340, $p$ =.12, φ =.152). Additionally, AAC users substantially decreased their likelihood of engaging in three or more hours per week of ECA compared to non-AAC users, as shown by the following statistics: $X^2$ (1, $N$ = 483) = 12.90, $p$=.01, φ =.157. Additionally, AAC users substantially decreased their likelihood of engaging in three or extra hours per week of ECA compared to non-AAC users, as shown by the following statistics: $X^2$(1, $N$ = 483) = 11.892, $p$ =.01, φ =.152.

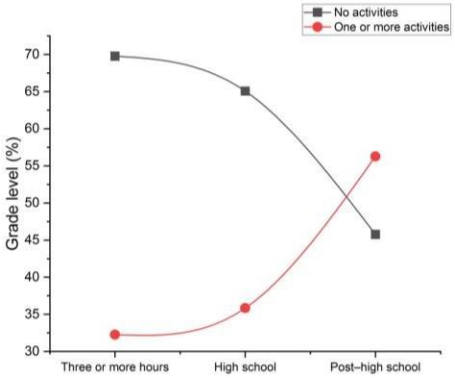


**Figure 4** Comparison of Grade Level.

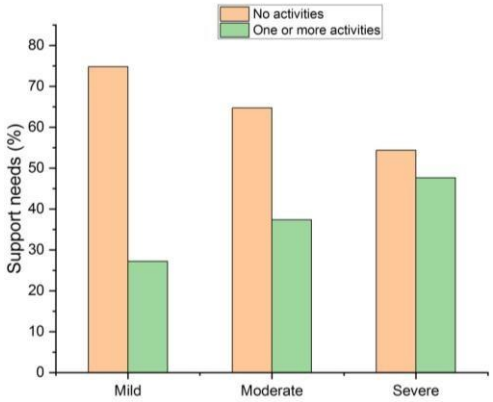


**Figure 5** Comparison of support needs.

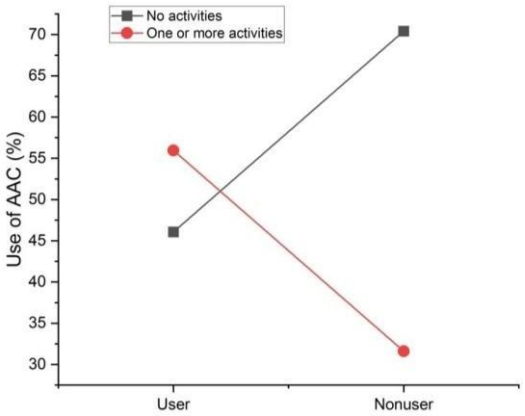


**Figure 6** Comparison of AAC.

**Table 2** Numerical Outcomes of Characteristics in ECA.

| | Three or more hours | | Less than 3 hr | | |
|---|---|---|---|---|---|
| Characteristic | % | n | % | n | $x^2$ |
| Support needs | 43.23 | | | | 12.41** |
| Mild (n=144) | 47.29 | 43.23 | 79 | 54.88 | |
| Moderate (n=135) | 33.6 | 47.29 | 105 | 51.53 | |
| Severe (n=135) | | 33.6 | 92 | 70.72 | |
| Use of AAC | 31.71 | | | | 12.90*** |
| User (n=113) | 50.27 | 31.71 | 80 | 72.32 | |
| Nonuser (n=38) | | 50.27 | 194 | 52.77 | |
| Grade Level | 48.24 | | | | 3.45 |
| Middle school (n=115) | 52.49 | 48.24 | 69 | 60.77 | |
| High school (n=334) | 32.35 | 52.49 | 175 | 54.76 | |
| Post-high The school (n=39) | 43 | 32.35 | 28 | 69.44 | |

*4.5. Characteristics and Activities Exclusive to Disabled Students*

There were considerable differences in the age group of the children; their assistance requirements, their use of AAC, and whether or not they took part in a minimum of one activity that was exclusive to students that had disabilities shown in Table 3. “In comparison to middle school students X2 (1, N = 152) = 8.41, p =.08, φ =.218, and high school students X2 (1, N = 375) = 6.040, p =.014, φ =.28), post-high school student were considerably further possible to take part in at least one activity that solely comprised students with disabilities. Students with severe disabilities were substantially other possible than students with moderate impairments to take part in at least one activity that was exclusive to individuals with disabilities, according to support needs, X2 (1, N = 277) = 13.59, p.001, φ =.213. AAC individuals were also noticeably more probable than non-users to take part in at a minimum one activity that was exclusive to students with disabilities, X2(1, N = 491) = 24.08, p.01, φ =.21”.

**Table 3** Numerical outcomes of Characteristics in ECA without Disabilities.

| | One or more activities | | | No activities | |
|---|---|---|---|---|---|
| Characteristic | n | % | $x^2$ | n | % |
| Support needs | | | 13.59* | | |
| Mild (n=144) | 39 | 29.22 | | 109 | 75.81 |
| Moderate (n=135) | 79 | 79 | | 137 | 65.69 |
| Severe (n=135) | 64 | 64 | | 73 | 55.39 |
| Use of AAC | | | 24.08** | | |
| User (n=113) | 64 | 56.96 | | 52 | 47.06 |
| Nonuser (n=38) | 119 | 32.62 | | 265 | 71.42 |
| Grade Level | | | 8.41* | | |
| Middle school (n=115) | 37 | 33.27 | | 79 | 70.75 |
| High school (n=334) | 118 | 35.86 | | 218 | 67.08 |
| Post-high The school (n=39) | 23 | 57.29 | | 19 | 45.75 |

## 5. Discussion

This research looked at how many intellectually disabled children in the secondary school participated in ECA organised by their schools (Tshegetsang 2022). Sports/fitness and school clubs were the two activity categories in which students engaged most often. Most kids participated for three hours or less each week on average in ECA (Oberle et al 2019), however, this time commitment varied greatly. Activities that are exclusive to kids with impairments only attracted less than half of all pupils. The kind of ECA students participated in, how much time they spent participating each week (Carbonaro and Maloney 2019), and how much they contributed to activities designed specifically for students with disabilities all had an impact on their need for assistance and the use of AAC (Spaaij et al 2019). There were several ECA offered by the school to students with intellectual disabilities, but sports and fitness had the highest participation rate (70.48%). revealed that 39.30% of children with intellectual disabilities, aged 13 to 17, got involved with school sports teams. These many discoveries may all be explained by several reasonable theories. Most significantly, previous research tended to concentrate on involvement in sports teams or school games, and then adopted a more inclusive period that included both sports education and strength. Another possibility is that although concentrated on a wider age range with a smaller group of people with intellectual impairment, the present research included secondary-age pupils throughout the complete spectrum of intellectual disability. According to the Centres for Prevention and Control of Disease, children and adults with intellectual and additional disabilities are most at threat of becoming obese (Lahham et al 2019). The prevalence of chubbiness for children with disabilities is 37% greater than the rate for children devoid of disabilities, and the rate for adults with disabilities is 58% higher than the rate for adults without disabilities. This makes the substantial number of people who participate in sports and fitness all the more interesting and supportive. It seems that, at least among the participants in the present study's material, a student's level of support requirements did not prevent them from participating in sports or fitness-related activities unless they also utilised AAC. When compared to non-AAC users, students who used AAC were considerably not as much of possible to engage in physical activity (Pickering et al 2019). Physical exercise has been shown to help prevent obesity and improve general health, thus it is important to figure out why kids who use AAC don't participate in sports or fitness at a comparable rate as their counterparts who don't use AAC. Our research raises concerns about why adolescents who need the most care are more likely than their classmates to participate in school organisations and special activities. It's possible that these activities provide more possibilities for involvement and are friendlier to those who need more help, or the parents have encouraged their children to take part in them. It's also possible that clubs and other ECA are easier to find inside schools, involve less weekly time commitment, have simpler participation criteria, or better reflect student interests (Luthar et al 2020). A grade was the only consideration that was irrelevant to the kind of activity in which students took part.

We projected that a much smaller amount of post-high school students would participate in school sponsor ECA since their friends their age are currently not in school, given the emphasis of post-high school programs on preparing young people for their teenage years. As a result, while participating in these activities, pupils could have access to classmates their age. There is a worry that these kids might not be able to utilise relaxation opportunities with peers their age during school-sponsored ECA since a substantial percentage of post-high school students (45.78%) did not engage in activities to facilitate solely involving students with disabilities. For people with intellectual disabilities, the kind of advantage and the quantity of time spent on activities that might predict such a benefit may vary. Additionally, because of their specific assistance requirements, some children with intellectual impairments may engage in activities different from those without disabilities. So, rather than activity duration, the intensity of participation may be a better predictor of educational value. The proportion

of students who engaged in ECA that is solely open to students with disabilities is the last topic worth addressing. Over one-third of all pupils took part in a minimum of one activity that was restricted to those with impairments.

## 6. Conclusions

The results of this research reveal that students with the most severe impairments engage in ECA less often than other students with intellectual disabilities and are extra probable to contribute to one or more activities that are exclusive to people with disabilities. School is supposed to suspiciously assess the kinds of ECA they provide and hurdles that may restrict contribution by kids who need considerable support requirements to promote the engagement of students with severe impairments. Given that these students were found to engage much less in sports education and fitness activities than non-AAC users, more effort should be put into discovering chances for them to do so. Finally, post-high school educational institutions should reconsider whether their extracurricular programmes are appropriate for this group of students and look for different ways to engage them in community activities that foster lifelong interests alongside peers their age who are not disabled.

## Ethical considerations

Not applicable.

## Declaration of interest

The authors declare no conflicts of interest.

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Increasing car washing competency in adolescents with autism and intellectual disabilities: Researching visual task evaluation

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**Abstract** This study looked at how well visual task evaluation helped teenagers with autism and intellectual disabilities become more competent at car washing. For disabled people to promote their independence and employment chances, car washing skills are crucial. The goal of this study was to ascertain whether training techniques that include visual task evaluation can improve car washing proficiency in teenagers with autism and intellectual disabilities. 30 participants, ranging in age from 12 to 18, participated in a pre-test/post-test design. Randomly chosen groups of participants were put into the evaluation group for the visual task or the control group. According to the findings, the visual task evaluation group outperformed the control group in terms of car washing ability. Adolescents with autism and intellectual disabilities can learn skills more quickly and become more independent by including visual task evaluation into their teaching strategies. These results demonstrate the potential for such treatments to enhance their quality of life and employment chances.

**Keywords**: handling conflicts, tactical decisions, emotional Intelligence, decision-making, leadership

## 1. Introduction

The quality of one's life as an adult greatly depends on one's employment. Employment benefits include better psychological wellness, family fulfilment, life satisfaction, perceived health, general quality of life, cognitive performance, and well-being. For people with disabilities, integrated employment is crucial to their full inclusion and engagement in communal life. It is essential to increase these people's access to top-notch research and career development suited to their unique requirements, preferences, and talents, as well as the labour market, to foster a more inclusive society for them (Cox et al 2017). Individuals with intellectual disability (ID) and autism spectrum disorder (ASD) currently have few employment options. Less than one out of five (20%) adults with autism or mental impairment disorder were employed in combined settings for employment between 2019 and 2020, according to current U.S. data; after graduation, 24% of Teenage grownups with intellectual disabilities and 33.9% of teens and adults with ASD are unemployed in the paid sector (Bishop et al 2018). According to studies, 30% of people with ASD are employed in the United States. However, only 50% of the 170 teens with ASD who participated in the study had paid employment, and 36% received social assistance. Developing and established nations acknowledge the importance of increasing work possibilities for people with disabilities beyond the United States (Whitesburg et al 2020). The Japanese government has dramatically increased accessibility to elementary learning and job prospects. For the approximately 38 million individuals of working age with disabilities, employment chances remain incredibly scarce despite significant government efforts to establish and safeguard labour opportunities.

The scarcity of resources for disabled persons to obtain adequate studies, work, or occupational skill learning is one of the main factors contributing to their unemployment, aside from ineffective law enforcement (Bergmann et al 2021). According to a recent study, over thirty percent (35.69%) of school-age Japanese kids with autism spectrum disorder either left early or never went there.

Additionally, transition programs are scarce or perhaps non-existent for the few teenagers and youths with disabilities who finish secondary school. Even if they are protected by the law, individuals with disabilities lack the necessary skills to work in environments that are competitive for employment because of their comparatively weak educational backgrounds (Root et al 2018). Video modelling and visual assistance are examples of evidence-based practices for instructing occupational abilities for children and adolescents people with autism spectrum disorder. Adolescents and young people with autism spectrum disorder have been taught several employment-related skills using video modelling in hypothetical or real-

world settings, such as mascot jobs. As well as fundamental abilities in environments like the workplace, bowling alleys, or supermarkets, such as aqua plants, supplying mail, and replacing paper towels. Some researchers used video modelling, which involved playing a clip of to-do chores on a portable device. This led to a rise in separate reactions and a decline in prompts in professional contexts. They coupled visual and audio prompting with video modelling, significantly boosting the accomplishment of a job on our own (Esposito et al 2017). The education findings above confirm the value of multimedia-based training for the learning and autonomous mastery of sophisticated technical abilities. In any workplace, it's crucial to complete independent jobs and engage in vocational activities continuously without taking frequent breaks. But in none of these research was, individual job participation quantified (Milligan et al 2017). Researchers were motivated to create these programs and assess their efficacy by the urgent need for job based on evidence abilities coaching courses for participants with ID/ASD in Japan. Since there are many car washes in the neighbourhood and Services for car washes are in high demand in Japanese suburbs, the job objective for this research was identified as knowing car washes. They provided competitive and integrated employment opportunities for people with disabilities through community-based training. The occupational skills training also consider the unique requirements of individuals with impairments, such as preferences, availability, and willingness. Both visual job analysis and Based on evidence approaches like video-based education help students learn new skills and complete jobs independently.

Questionnaire 1: How well did training help with accuracy when performing the car wash jobs?

Questionnaire 2: How much did training affect how engaged students were with their jobs?

Questionnaire 3: How well was the learned car wash techniques kept up?

The remainder of the paper is divided into subsequent parts. Part 3 contains the proposed method explained. Part 4 contains the results and analysis, while Part 5 discusses the conclusions.

## 2. Literature Review

Hart, 2021 stated special education services are provided to numerous people with Autism and other developing disorders to address weaknesses in cognitive and adaptive functioning. These deficiencies affect the student's capacity for independent participation in daily activities. To address these deficiencies across multiple special education classes, there are, however, few generalizable programs available. In research including 14 people, ages 13 to 18, who were diagnosed with autism spectrum disorders, intellectual impairments, studying disabilities, and multiple disabilities, two modules from the Healthy Relationships Curriculum were evaluated for effectiveness. Pfeiffer et al (2020) explained serious transportation issues frequently prevent individuals with intellectual and developmental disabilities (IDD), especially Autism Spectrum Disorders (ASD), from accessing healthcare, participating in their communities, and finding work. People with IDD may be able to get over transportation obstacles with the use of travel training, which uses one-on-one coaching. This study sought to determine how a thorough travel training program affected the travel abilities of people with IDD. Rosello et al (2020) aimed one of the essential ideas in the study of social thinking, particularly in the context of autism spectrum disorders (ASD), is the theory of mind (ToM). There is a large and convincing body of literature demonstrating deficiencies in ToM in people with ASD. The diverse profile of ToM skills in kids with ASD and the relationship between various ToM development levels and social, sensible, and adaptive behaviours in daily life are two linked concerns that need further study. Babb et al (2019) described, Executive function (EF) problems are frequently linked to autism spectrum disorder (ASD), which significantly affects how difficult it is for people with ASD to live independently, especially when it comes to social skills. Technologies present promising chances to design EF intervention programs for autistic youngsters. Most therapies discovered improved EFs and lessened symptoms in kids and teenagers with ASD. On its generalization to untrained talents (i.e., social abilities), as well as their long-term impacts, there is a lack of research. Shkedy et al (2021) stated from 2011 to 2017; there were 7.0 million children with disabilities enrolled in public schools that were covered by the Participants with Disorders Education Act (IDEA), a federal legislation. The current curricula provided to students with special needs are diverse and incoherent because they differ amongst students, classes, districts, and the entire country. Øzerk et al (2021) expressed one of the most critical areas of human growth is social development. A lack of social skills can have a detrimental effect on several vital areas, such as academic performance, interpersonal interactions, behaviour, psychological wellness, and adult life outcomes. Those who have autism typically lack basic social skills. Children with autism frequently fail to develop social competence. They may encounter difficulties in the family, school, and community contexts without the support and efficient therapies to improve social skills. Ketelaars et al (2017) suggested women with autism spectrum disorders (ASD) may exhibit a distinct, less obvious clinical expression. The study of potential underlying mechanisms that could be responsible for the female phenotype is, however, still in its early stages. Stiller and Mößle (2018) explained children and teenagers with autism spectrum disorder (ASD), and those without it now live almost exclusively on screens. This systematic review offers a current summary of screen media's importance in the lives of kids and teenagers with ASD. They found 50 research examining media consumption among kids and teenagers with ASD from 2007 to 2021. According to this research, screen media is a child or adolescent with ASD's favourite form of recreation, with varied results compared to those without ASD.

## 3. Methodology

*3.1. Participants*

WeChat, a popular social media on mobile devices platform in Japan, was used for enlisting volunteers for this study from a nearby parent support group (Table 1).

**Table 1** Inclusion and Exclusion criteria.

| Inclusion Criteria | Exclusion Criterion |
|---|---|
| Age: 14 to 20 years old | already received instruction in car cleaning |
| Dual diagnosis of Intellectual Disability (ID) | Concurrent vehicle washing training was intended to be obtained. |
| Autism Spectrum Disorder (ASD) | the investigation |
| Able to watch what others do and copy it | |
| collected with the consent of the participant's parents | |

His IQ was 45 on the Wechsler IQ Grade for Kids IV in Japanese. He had an ASD diagnosis that was considered severe (score: 37) using the Japanese version of the Children's Autism Measure and the ASD standards in the Diagnostic and Statistical Manuel of Psychological Illnesses. The parents claim that from the age of six to thirteen, at a private institution, Kao received in-depth instruction in speech, academics, and motor abilities. Also, when he was 13 years old, he spent a month in a rehab facility, where he had received some basic training in restaurant duties, including dishwashing, arranging tables, placing orders, and cleaning up. He created phrases with two words for communication, enquired about favourites, tagged over 50 everyday sections, and addressed social concerns. He was reading at a level equivalent to about first grade. He could dress, maintain his appearance, and tidy up his place. But he needs supervision and adults giving him instructions to finish his job.

Male, age 16, with moderate ID and ASD, Ray. His Vehicles rating in the extreme categories was 38, and his WISC-IV rating was 40. From primary to middle school, Ray attended public schools, and his mother accompanied him to class every day. After finishing middle school, he stayed home with his parents, where his mother showed him how to conduct household jobs and brought him grocery shopping. Ray could use simple communication techniques, such as asking for select products, tagging above 52 commonplace objects, and responding to social cues. His writing and reading abilities were roughly on par with second-graders. He was also capable of performing simple self-care jobs, including grooming, taking a shower, doing the dishes, and doing the laundry. However, he needed many prompts and supervision to finish them. Before the study, he had never had any training in vocational skills.

Lon, a 20-year-old male, was identified as having moderate ASD and mild ID. Lon can write and read at the third-grade stage and has rudimentary communication abilities. He could take care of himself and maintain a daily schedule, including getting dressed, grooming, doing laundry, and cleaning his room when provided a list of things he could purchase in a grocery store alone. He could wash his dishes after meals and tidy up his room. From primary to high school, he was enrolled full-time in a unique education program. After graduation from high school, he had undergone three days of daily, two-hour instruction in vocational skills in a rehabilitation facility. Basic computer knowledge, the use of search engines, and mail delivery were all part of his professional development program.

*3.2. Arrangements and Resources*

The study was carried out in a Japanese interior city suburb. The university-affiliated autism study centre’s conference room was the location of Part 1 of the training, which included a movie and instruction. Part 2 of the training included washing an automobile, which was done in a business with manual vehicle washes. The vehicle wash served as another location for the probe periods. After part 1 was finished, the teacher, parent or guardian, and child either got a ride, if there was one or walked for around 22 minutes (1.3 km) to the vehicle wash. Part 1 coaching was carried out elsewhere because there wasn't enough room in the car wash.

A female special education graduate student served as the instructor. During Part 1 training, the conference room was empty except for the trainer and the student. A pc, a chalkboard, a projection display up forward of it, a desk, and two stools could be found in this 6m x 5 m x 4 m room. To capture the meetings, a video cam was mounted on a tripod. One automobile could be washed in the 5 m by 5 m by 3.5 m car wash. Near the entryway on the front left side, an aqua pipe was positioned. At the far left side, adjacent to a tap, was where the sponge and bucket were located. In the forward right corner, near the entry, there was a holder with towels and liquid soap. Right next to the wash station was the workplace and the waiting room. Occasionally, the car wash's owner(s) and the participant's parent might stop by the office or waiting room to see a training session. Customers of the car wash did not have to stand by their because delivery and pickup services were available. The periods were recorded with a video camera mounted on a tripod.

In the Part 1 learning periods, there were four video clips used, one for each objective job. The teacher acted as the model, outlining and showing each step of a particular assignment. Every video clip lasted between 4 and 6 minutes. In addition to Oral comments provided by the modeller and illustrations of each action in a target assignment, the specifics of each phase (for example, wholly zoomed in for larger pictures, sprinkles aqua on every inch of the car's bodywork. The PC in the room was used to display the videos. The twenty laminated picture cards that comprised the visual job analysis were total. Each image card (13.9 centimetres 16 centimetres in size) had an image of one stage in a specific job and written explanations of that the following image (for example, taking out a aqua pipe). The learner could see these images on the wall since they were there. The jobs and steps are listed in Table 2 for convenience. Cars were used for the videos and graphic assignment evaluations, while vans, SUVs, small vehicles, and sedans that customers voluntarily contributed were used for the hands-on training. Due to the worker's training as a student with a disability and the fact that there wouldn't be numerous workers washing the car at once, the customers were advised that it would take between 30 and an hour.

**Table 2** Techniques in Every Vehicle Cleaning Service.

| jobs | Steps |
|---|---|
| A: sprinkle aqua | A1: removing and reattaching the aqua pipe |
| | A2: Spraying the car's outside (including the front, back, top, left, and right sides, as well as the wheels) |
| | A3: activating the aqua pipe |
| | A4: taking the aqua pipe out |
| B: Wash the vehicle with foam aqua. | B1: Restoring the bucket and scrubber |
| | B2: cleaning the scrubber and add aqua |
| | B3: Vehicle cleaning (front, the top, backward, left, both sides of windshields) |
| | B4: Fill the container with aqua, then wet the scrubber. |
| | B5: putting the soap pipe back after turning off |
| | B6: The front, back, top, wheels on the left and right sides are all sprayed with the soap pump. |
| | B7: Activating the soap pipe |
| | A8: taking the aqua pipe out |
| C: Wash the vehicle with aqua. | C1 to C4: similar to A1 to A4 |
| D: With a towel, Wipe off the car. | D1: placing the used clothing in the hamper for laundry |
| | D2: drying both the right and left faces |
| | D3: wiping the vehicle (including the front, back, top, and windshields) |
| | D4: obtaining a fresh towel |

*3.3. Laboratory Design*

To assess how well training affected assignment evaluations and the acquiring of car-washing skills, this research used a repeated probe over 4 behaviours sketch. The four targeted duties (i.e., Job A: sprayed aqua, Job B: washing the car with foamy liquid, Job C: washing the car with aqua, and Job D: wiping the car with a towel) was created after job analysis of the target car washing abilities, and each job had numerous steps. The training includes visual job analysis, video modelling, and a present hierarchy of prompts. When a stable baseline had been established, Job (A) training was started and continued until the criteria results of 100% for two continuous periods, at which point Job (B) training began. The following jobs were trained similarly. After each activity met the required standard, persueprobing periods were held 7 days later, 14 days later, and 183 days.

*3.4. Procedure*

Periods for probing various situations: To assess each pupil's development of skills progress over time and as a test of proficiency for every assignment within the training environment, probe periods were done consistently throughout the starting point, training, and persueconditions. Before Part 2 of the day's training within the coaching circumstance, a probing session was held. The teacher provided the equipment and delivered straightforward verbal instructions with specific phrases for each job throughout probe periods (for example. "Scrub car with soapy aqua"). The teacher then gave the pupil 10 seconds to reply. After each activity, the instructor complimented the student for doing an excellent job on each step that was completed correctly. The teacher made a neutral comment while ignoring incorrect answers (such as "Thank you for your work" or "Let's do something else") if the student failed to follow the instructions precisely or failed to react within 10 seconds. The linked replies over conditions were examined for all four jobs. If the learner lacked the necessary abilities to complete the assignments, the initial probe session lasted between 6 and 13 minutes. A second probing session, lasting between 23 and 30 minutes, took more time. In the practice circumstance, Job A was probed; afterward, Job A was acquired,

and Jobs A and B were examined as chained replies after Job B was obtained. Because Job C was the same as Job A and the students mastered Job C without training, probe periods for Jobs A, B, and C was skipped. Following this timetable, persueprobing periods were held: 7 days, 14 days, and 183 days after each job had been mastered during the program.

Periods of instruction: Each session of education had two sections. The conference room served as the location for Part 1 and the car washes for Part 2 of the training. The first training session included a video demonstration and guidance. The first table is titled "Car Washing Steps in Each Job." Activity Step A: sprinkle aqua A1: Extending the aqua pipe A2: Activating the aqua pipe A3: A car's outside being sprayed A4: Detaching and reattaching the aqua pipe. B: Wash the vehicle with soap and aqua. B1: Removing the soap pipe B2: Activating the soap pipe B3: Using the soap pipe to squirt the front windscreen, top windscreen, rear windscreen, left part and wheels. B4: Disconnecting the detergent pipe and reattaching it B5: Bucket loading with aqua and soaking the sponge B6: Detailing the vehicle's exterior .B8: Restoring the towel and the bucket after B7: Cleaning the sponge C: Wash the vehicle with aqua. Identical to A1-A4 for C1-C4. D1: Obtain a clean towel D2: Dry the vehicle (including the front windscreen, top windscreen, and back windscreen). D3: draining the left and right positions D4: Placing the discarded material in the laundering basket. A target job video was delivered by the instructor in Lee et al. Second, the instructor showed the relevant image while pausing the video after each step. Third, the teacher instructed each pupil to explain the procedure by analysing the text located at the base of each image. Fourth, the teacher gave positive feedback for appropriate reaction or used echoic suggestions to elicit appropriate responses. Fifth, the teacher went through the remaining stages in the same order until they were all demonstrated and explained. The learner was then requested to arrange the photographs in chronological sequence and define the steps when the instructor had finished. When a job was completed using the method outlined above, Part 1 came to a close. Each training session for Part 1 lasted roughly 15 minutes.

Practical training in the vehicle wash made up Part 2 of the program. First, the teacher arranged all of the images on the wall in chronological sequence. Second, the teacher instructed the pupil to go through the photos by outlining each step. The resources required for the activity were also presented by the instructor. Fourth, the pupil started completing the job's steps. When the student completed each stage successfully, the teacher offered encouragement. The teacher provided a gestural prompt (such as indicating the picture) combined with a voice explanation (such as "Pull out the pipe") for the learners to answer if they learners skipped a process. If this happened, the response was noted as being incorrect. After giving verbal and gesture instructions, if the pupil still didn't answer correctly, the physical direction was given.

In this research, we only used Ray's physical input to start Job a training periods. When every step in each activity was finished, Part 2 of the instruction ended. The training process for Job B was completed once the student met the criteria for Job A. Once the student met the requirement for Job D, the coaching process was repeated. The duration of each Part 2 workshop contends from 15 to 20 minutes. The student began each visit by receiving Part 1 teaching for the assigned job, was driven to the car clean, had one period of probing the skill(s) they had mastered, and then received Part 2 instruction for the target job. The entire coaching circumstance took between four and six weeks to complete, and every student received three to four visits per week.

### *3.5. Defining Responses*

The percentage of accurate answers for every assignment and the proportion of probing session job involvement across circumstances were the dependent variables. A proper response was one that the student independently completed and matched the description of the step-in question. Each of the four stages in Job A, which involved spraying aqua, was included as a response. For step 3 to count as a correct reaction, the learners had to wet every part of the vehicles outside. The accuracy rate for Job A in that probing session was 25% if the learner had a correct answer out of all four phases.

In the starting point, learning, and persueprobe periods, where all of the jobs were completed by the students as chained replies, job participation was evaluated utilizing 30-s momentary time sampling. When a student spent more than three seconds on a job during each time sample interval without taking a break or engaging in disruptive behaviour, it was considered an instance of job engagement. Disruptive behaviours involve speaking out of turn, averting your gaze, making pointless, repetitive gestures, or moving about.

### *3.6. Social Acceptance*

We created questionnaires and asked each child's parents, the two car wash shop owners, the motorists who wipe cars the students washed at continuation probe events, and the children who took part in the study for their opinions to determine the social validity of the study. The questionnaire for parents has 15 sections (Sections 1–6 regarding the acceptability of the learning, Item 6 regarding the perceived value of the teaching, Item 8-11 pertaining to viability, and Sections 12–15 regarding satisfaction). The course's content, the vehicle wash procedure, the individual learning format, and the practice chances were the first through fifth sections, and they were all considered acceptable. Section 6 questioned the parents if the training had improved their child's career abilities. Sections 7 through 10 dealt with the program's viability regarding the length of periods each week, the size of each one, the cost, and the amount of time needed to complete the

training. Sections 12 to 15 dealt with how pleased parents were with the instructor, the job involvement, the development of their child's vocational skills, and the acquisition of car wash skills. Every item was scored using a Likert-type scale with a maximum of five points. The final query was an open-ended one that asked parents to share what they learned from the intervention, their feedback on the interference, and suggestions for program enhancement.

Researchers spoke with each student individually during a brief interview to gauge their level of satisfaction with the course overall. The four inquiries were, "Do you enjoy car washing? If so, which feature is the best? Why not, then? "How do you like the teacher?" How do you feel regarding the cars you just cleaned? And "Are you interested in working in a car wash in the future? For or against? Open-ended interview questions were used with the two auto cleanse owners. Questions like "Are you happy with the outcomes of this training?" were among them. Is there something you could recommend to make this training better?

During the persueprobe periods, we only asked individuals to wipe cars our participants thoroughly washed to respond to the questionnaire we designed for the clients who gave their vehicles for the training. (A) Is the length of time that customers must wait for a vehicle wash sufficient? (a) Is the price reasonable? (c) Do you think the service was satisfactory? Any ideas for improvement if not? (d) Are you concerned about having people with impairments wash your car? (e) Are you prepared to have your automobile cleaned at a facility run by people with disabilities? And (f) any further remarks or training-related recommendations?

### *3.7. Procedure Adherence and Interobserver Consensus*

One supervising professor from the institution evaluated 30% of all the instruction events for all learners and 30% of the probing events for each individual and in each condition, evaluating procedural fidelity on-site or through video recordings. The sections with implementing steps were listed on a checklist. The objective job had to be introduced, the video clip's action had to be shown, the picture/question had to be delivered, and the consequences had to be given. These were all elements on the checklist for Part 1 of the training—each step of the job involved repeating sections (b) through (d). A verbal direction and materials presentation, a visual representation of the objective job, and a discussion of the consequences were all part of the Part 2 training. A reminder in the tree structure for an inaccurate reaction or no reaction was the consequence in Parts 1 and 2 of the movement. Every one of the 20 steps for every job was specified on the checklist for probing periods. Each phase involved (a) giving verbal instructions and waiting for 10 seconds before giving supplies and (b) praising a good response while disregarding a bad one. By multiplying the number of particular sections by the total variety of sections on the list and dividing the result by 100, the degree of operational fidelity was determined. For all periods evaluated, there was 100 percent functional fidelity for probe periods. The procedural faithfulness for the learning periods varied from 93.9% to 99.6%, with a mean of 96% for all observed periods.

A graduate candidate who had been instructed to capture student replies from the visual recordings conducted interobserver agreement (IOA) assessments for every learner from each condition for 30% of the probe periods. IOA was computed by multiplying the variety of deals by the sum of the agreements and disagreements. The average IOA for vehicle wash jobs was 96% (ranging from = 93%-99%), and for all periods examined, it was 93% (content = 90%-100%).

## 4. Result and Analysis

### *4.1. Accuracy of Work*

Figures 1, 2, and 3 depict the rate of reaction for Jobs A, B, C, and D. Except job C (ranging from = 30.6%-100%), Kao's job accuracy was rather steady during baseline for every job (Job A: M = 38.1%, ranging = 31.6%-42.9%; Job B: M = 45.1%, content = 33.9%-49.2%; Job D: M = 38.1%, content = 34.6%-36.8%). Before meeting the mastery requirement for Job A, Job C's performance was on par with the other assignments in the baseline. Kao's accuracy under the coaching condition soon rose to an excellent level. He met the criteria for Job A in five periods (with a content of 88.8%–100%), Job B in seven periods (with a content of 77.9%–100%), and Job D in six periods (with a content of 79.9%–100%). Between the baseline and training conditions, there was no data overlap. One week after completing Job A, Kao continued to perform with 100% accuracy throughout persueperiods. He also performed flawlessly when learning jobs (such as AB and ABCD) were chained together. He continued to complete all jobs with 100% accuracy one week, two weeks, and six months after the instruction was over. Similar to this, Ray's accuracy was low and consistent at the start for Job A (M = 29.9%, content = 29.6%-29.7%), Job B (M = 15.1%, content = 8.7%-16.9%), and Job D (M = 19.6%, content = 11.5%-22.1%), but increased after mastering Job A to learn Job C (content = 30.6%-100%). His accuracy on each job grew right away to a extreme level, and under the learning circumstance, he reached criterion performance. He completed Jobs A, B, and D in a total of 5, 7, and 6 events, respectively (M = 85.7%, content = 72.3%-100%; Job A: M = 89.5%; Job B: M = 55.6%; Job D: M = 77.5 %;). Between initial and training conditions, there were no data overlaps. During persueprobe periods conducted a week, two weeks, and six months later, he kept up acquired duties and completed them in a linked order with 100% accuracy. Job A: content = 43.5%-77.5%; Job B: content = 48.3%-66.4%; Job C: content = 44.2%-100%; Job D: content = 23.1%-44.1%). Lon had a relatively high job performance during baseline compared to Kao and Ray. He also completed Job C after meeting the requirements for Job A.

He mastered Jobs A, B, and D in four, two, and three attempts, respectively (M for Job A: 100%, content: 100%-100%; M for Job B: 98.1%, content: 92.3%-100%; M for Job D: 96.5%, content: 89.5%-100%). His accuracy instantly climbed to near the criterion achievement during training. There was no overlap between the baseline and training conditions' probe data. In 1-week, 2-week, and six-month persueprobing periods, he performed acquired activities at a 100% level.

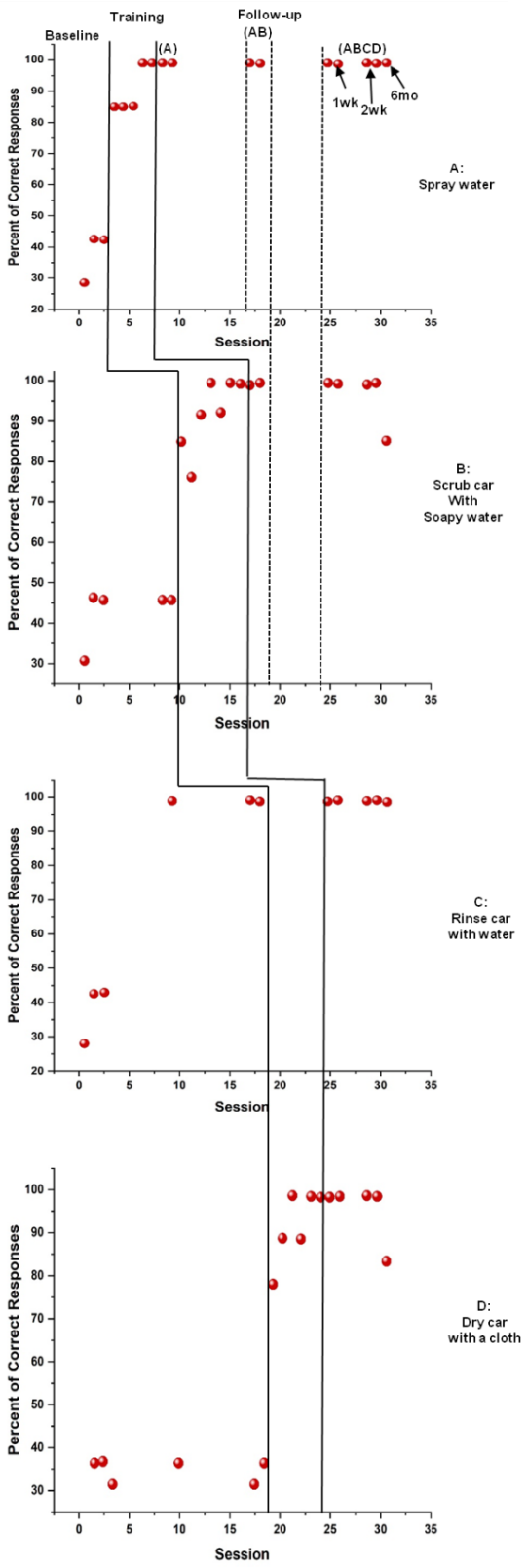


**Figure 1** Percentage of correct answers for job A through D for Kao across conditions.

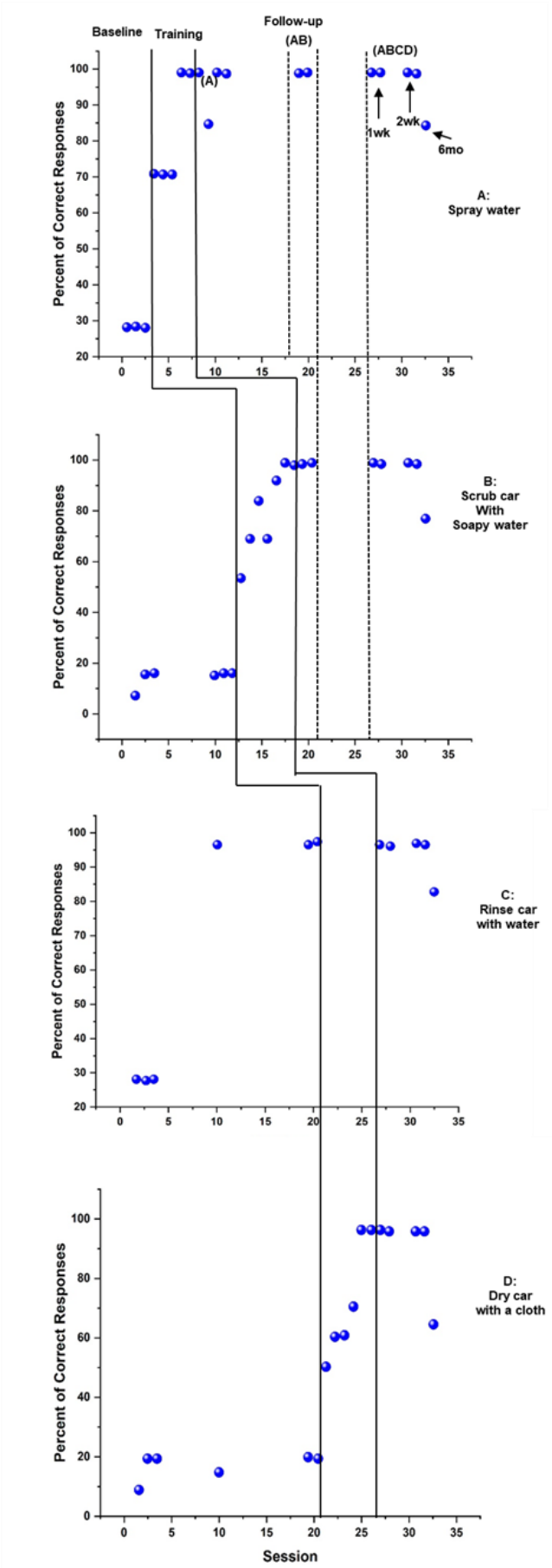


**Figure 2** percentage of accurate answers for Ray's job A through D under all situations.

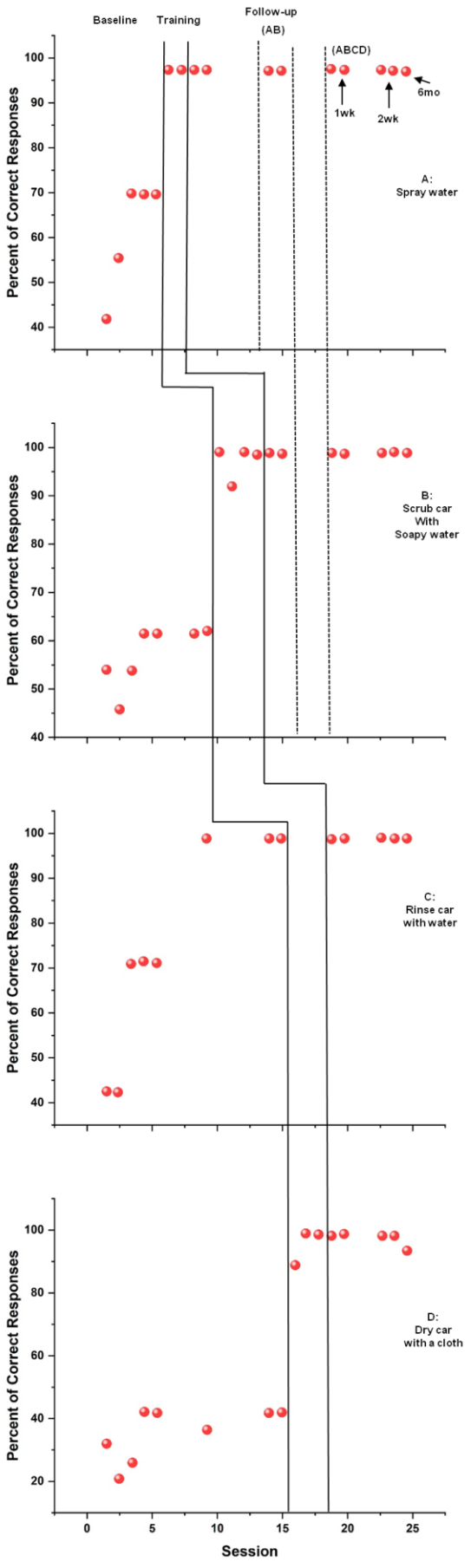


**Figure 3** Percentage of accurate answers for Tasks A through D for Lon across conditions.

### *4.2. Job Participation*

The rate of learner job engagement for the beginning, learning, and persuecircumstances is shown in Figure 4. Kao's job engagement was somewhat higher during the training scenario (M = 90.7%, content = 88.3%-93%) than at the beginning of the study (M = 87.8%, content = 86.2%-89%). It has remained there during the following periods (M = 94.6%, content = 95.8%-96.4%). Between the baseline and training conditions, there was one data point overlap, while there was none between the initial and persueperiods. Ray and Kao similarly engaged in jobs. His job engagement remained stable at an elevated level when follow-ups (M = 95.7%, content = 92%-97.8%), after increasing with an upward trend to an extreme level beneath the learning circumstance (M = 85.7%, content = 77%-94.4%). His job involvement was stable at a comparatively minimal level during the starting point (M = 70.5%, content = 61%-76%). There was just one point of data overlap between the baseline and the training session, and there were none between the baseline and the persueperiods. Throughout the initial training and persueconditions, Lon's job involvement remained constant and high at 100%. The data trend did not change.

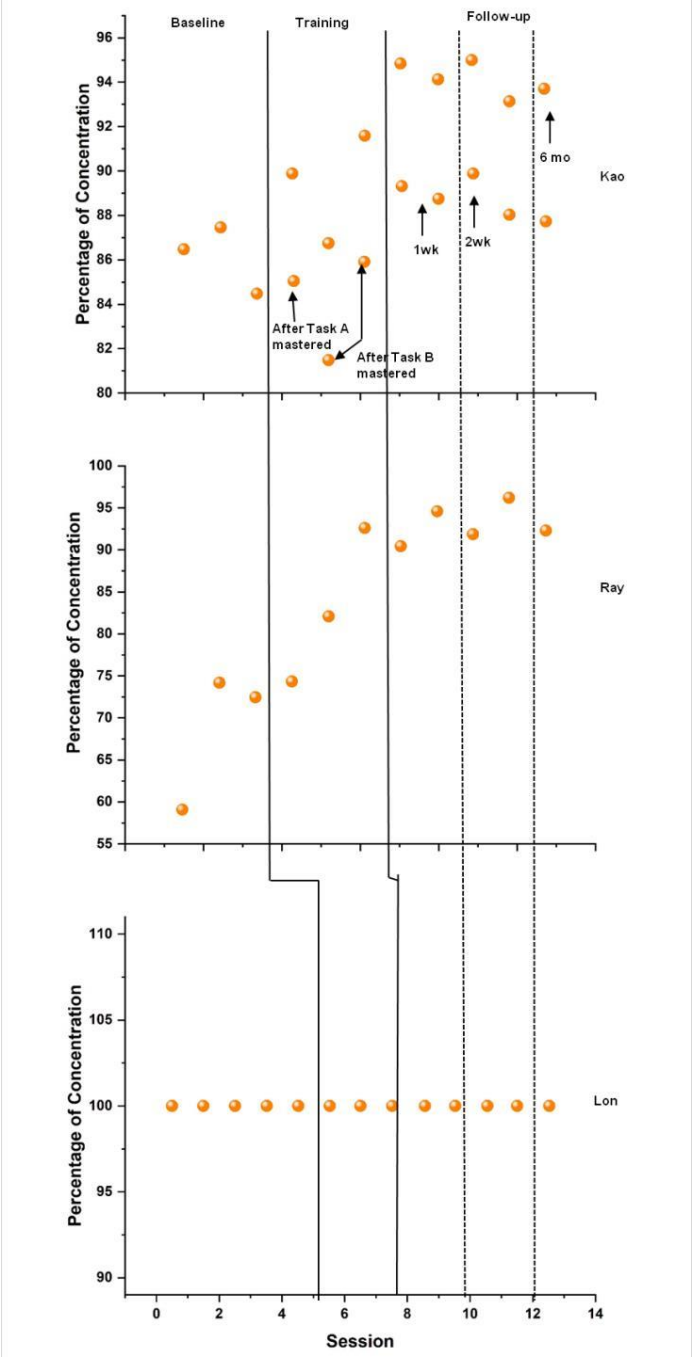


**Figure 4** percentage of each student's participation in tasks ABCD under various conditions.

### *4.3. Social Acceptance*

The three parents gave the training an average evaluation of 5.90 out of 6 (SD = 0.15) for acceptability, 5.60 out of 6 (SD = 0.45) for perceived usefulness, 6 out of 6 (SD = 0) for usefulness, and 5.58 out of 6 (SD = 0.33) for fulfilment. The learning was well-received by all three pupils, who replied. According to Kao, cleaning the car with foamy aqua was the most excellent part because the formation of foam made the car look cleanse. Ray was skilled at aqua spraying. Thus, he enjoyed doing it. Because it was the last process and made the automobile incredibly clean, Lon enjoyed drying the car. The three students were pleased with the vehicles they had cleaned and with the instructor. Kao and Ray expressed their happiness at being able to thoroughly wash the automobile by themselves. Lon claimed that by paying attention, he kept the cars clean. Ray and Kao stated they were interested in employing at a car wash since it would be lucrative. Car cleaning is exhausting, Lon stated. The teacher asked, "What if they reward you for doing it?" Lon then retorted, "Oh, I will do it then." The car cleanses station's proprietors said they were pleased with the coaching outcomes. One person noted that the trainer may have instructed the trainees to use lesser foam. Another said the time the clients had to wait could have been reduced. Both business customers expressed a desire to keep using their car cleans as a place where people with disabilities can get training for jobs. Additionally, they would take into account employing individuals with ID or ASD.

A questionnaire was given to 9 out of 35 clients' pipe automobiles our students washed. With the take and delivering services offered by the car cleanse, they said the wait time of 60 minutes was reasonable. Additionally, they thought the prices were fair compared to those at other vehicle washes. They were pleased with the calibre of the service as well. A supervisor being present, according to one customer, was a good thing. One of his car windows, for instance, wasn't entirely dry, but the issue was soon resolved once he spoke with the manager. Although every customer admitted to being concerned about the students unintentionally scratching their automobiles, the findings proved differently. One client observed that the learner who cleaned his car was exceedingly cautious and paid close attention to detail. All the clients said they have no issue with future vehicle washes being performed by people with disabilities.

## 5. Conclusion

Research priorities in Japan include creating and analysing evidence-based instructional strategies for teaching occupational skills to people with ID. One of the early studies to assess the impact of video modelling and video analysis of jobs on acquiring, maintaining, and involvement in vehicle cleansing for teenagers with ASD was the one reported in this article. The program was successful in passing on and preserving the abilities of all three participants, according to the results. After the training was over and during the subsequent probe periods, three of the participants' job engagements improved.

The study's limitations include the absence of a controlled experiment for Job C, the absence of a section assessment allowed in the research sketch, and the inability to generalize newly learned skills to other contexts. In our experiment, we used a multiple-probe approach to teach a chained behaviour using four distinct challenges. All students learned Job C without any more training after mastering Job A, which interfered with the experimental control that the design required because Jobs A and C had the same processes. Perhaps a variety of probes across individual plans would be more suitable. Determining if each component used in the learning periods was required was also challenging without component analysis. Each visit may also last an hour within the learning conditions. The effectiveness and viability of the movement are now a cause for worry. In the vehicle wash facility, it might be essential to show films, employ video prompting techniques, and brief video clips to teach one behaviour after another while also providing comprehensive job training. Future studies should assess if it is possible to generalize car wash knowledge to another car cleans or not.

The findings significantly impact creating of efficient occupational skill development programs for people with autism spectrum disorder in Japan. Practitioners may want to think about teaching sophisticated occupational skills to teenagers with autism spectrum disorder by using visual simulation for fundamental instruction and visual evaluation of jobs in a real-world work environment. Since the method is efficient and promotes independence in work completion, it can also be used in particular education institutions or job support facilities for people with ID/ASD. The course of study is practically viable for companies who might think about hiring people with ID/ASD to operate in their facilities, given that these people have access to supervision and video equipment.

**Ethical considerations**

Not applicable.

**Declaration of interest**

The authors declare no conflicts of interest.

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Regions with the highest rates of teacher certification and students' cognitive milestones with learning disabilities or emotional/behavioral issues

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**Abstract** The teacher's special education certification (SPEC) degree is a barometer for their competence in study, practice, and policy. This research compared the test scores of elementary and middle school children with learning disabilities and emotional and behavioural disorders taught by Special Education Teachers (SET) to those of students who General Education Teachers (GET) led in the same subject areas. The type of certification for teachers has little impact on most student groupings. In Learning Disabilities (LD) and regular education, students with LD and more extraordinary intellectual ability performed better in English language arts (ELA) with a trained teacher. Students with Emotional Behavioural Disorders (EBD) who were less proficient in mathematics were less likely to be helped by SET compared to General Education (GE) and Licensed Special Education Teachers (LSET). These words' actual meanings are examined concerning SET quality measures. The outcomes reported here should be understood under several constraints. Operational datasets, like the one utilized in this study, rarely contain data on crucial factors that affect an exceptional education-certified or dual-certified teacher's capacity for effectiveness.

**Keywords:** dual certification, SET, ELA, GET, LSET

## 1. Introduction

With average intellect and reasonable educational and socio-cultural chances, specific learning disabilities (SLDs), and neuro-developmental disorders, are defined by difficulties with reading, writing, and math skills. SLDs happen without mental, sensory, or neurological problems (Cristofani et al 2023)**.** Emotional-behavioural Disorders (EBD) are provided to an estimated 353,000 students in the US (Gersib and Mason 2023). Because these instructors were certified in SE, the proportion of SWDs in their classes needed to match their propensity to leave their positions. Secondary-level reading difficulties are considered more severe than those at the elementary level. However, as it is believed that one of the duties of elementary school teachers is to train students to read fluently, this is primarily done at the lower levels. As a result, secondary reading promotion is frequently disregarded (Barwasser et al 2021). Reading, writing, speaking, and listening are just a few functional skills that are impacted by learning disabilities. Information receiving and retrieval are different idiopathic abilities (Nasir 2020).

Teachers are essential in helping children with EBD overcome their significant academic (SA) and social-emotional (SEO) challenges. Due to their low intellectual accomplishment and problematic behaviours obstructing progress, students with EBD need numerous opportunities to respond to academic cues, frequent feedback, and evidence-based method (Cumming et al, 2021). Instructors refer students who may have SE needs to the Student Services branch of the Ministry of Education, which determines the least restrictive placement option (Griffith et al, 2022). ID symptoms can range from mild to severe, depending on the disorders underlying cause. This is crucial for figuring out what kind of help is needed, allocating resources, selecting study subjects, and even for legal reasons (Tafla et al 2021). Less than one percent of children ages 3–21 who meet the criteria for emotional disturbance under the Individuals with disabilities education act receive SES (Leggio and Terras 2019). This study examines the regions with the most excellent rates of teacher certification as well as pupils' cognitive development and emotional/behavioural milestones.

## 2. Literature Review

Watts et al (2023) demonstrated our ability to comprehend the perspectives and experiences of academics working with students with intellectual disabilities. Using Bronfenbrenner's bio ecological approach, Collins et al (2022) investigated how students' senses of self, competence, and pride develop in response to their experiences in the classroom and the wider world. The proportion of SWDs in these teachers' classes did not correlate with their odds of leaving the profession because special education certification (SPEC) attenuated this association Gilmour and Wehby (2020). Bullying from peers is more likely to occur in kids with learning and developmental issues, according to Peguero et al (2020). Compared to young people with visible disabilities, those with invisible disabilities are less likely to be bullied in isolated situations. Two children with LD had their emotional and academic growth measured after completing a computer-based training program. After completing a computer-based training program, two children with LD were assessed for their emotional and academic development by Siouli et al (2020). Layden et al (2022) looked into the career objectives of SETs who deal with children who have intellectual disabilities (ID), developmental delays (DD), and autism spectrum disorders (ASD) using an online poll. Rimfeld et al (2019) looked carefully at the demographics of the lecturers. Over 16,000 twins were included in the twins' early development research, a longitudinal study of twins using national birth records, between 1994 and 1996. According to (Yang et al 2019), were 9,295 pupils enrolled in total, whose ages ranged from 6 to 16. Van (2022) examined how school-aged children with SLD, ADHD, and ADHD with SLD could think and behave. Information on sixty-six kids from a far-flung region was saved for the study. Hamzah et al (2020) interviewed educators to discover what they knew and how they felt about the topic. Eratay (2020) designed to assess the effectiveness of teaching young persons with intellectual disabilities the leisure skills of marbling and stone painting through direct instruction. Goldman and Gilmour (2021) reviewed three years of state administrative data on special education (SE) kids in grades 4-8 with ASD. Brunsting et al (2022) examined increases in burnout among 230 special educators dealing with adolescents who had emotional and behavioural challenges in 15 school districts across the country who were selected using stratified random sampling throughout three periods in a school year. Nine high schoolers with emotional and behavioural issues received training on writing argumentative essays to advocate for their needs related to the transition (Cuenca et al 2019). Dellatorr et al (2022) examined how high-ability or gifted (HIAs/G) parents view family relationships, educational practices, indications of emotional/behavioural problems, and possibilities for their teenagers. Means (2019) determined the qualities of a professional development program that would make it easier to handle kids who have EBD or who are at risk for developing it in the classroom.

## 3. Methodology

The standards for teacher certification can range from one nation to another, as well as from various states or regions. Cognitive milestones are developmental signs that show typical advancement in cognitive skills like language learning, problem-solving, attention, memory, and social cognition. On the other hand, LD is a neurological condition that influences how people with average or above-average intellect process and react to information.

### *3.1. Data source*

Data about students, teachers, and schools in North Carolina (NC) are collected and submitted annually for use in state accountability measures. Students in grades 4-8 at regularly scheduled public schools in NC who had ever been diagnosed with a condition qualifying them for SES and had an Individualized Education Program (IEP) were included in the sample. Throughout the study period, SWDs in North Carolina could take traditional or adapted tests. Most kids with LD or EBD could finish the regular or adapted tests, but the few who spent the extra test were disqualified. Because the modified assessment revealed that children had increased learning needs, researchers could explore disability heterogeneity within that sample. So that test results from several years could be compared, students who took a new kind of exam each year were disqualified. If a student's test scores or demographic information are missing, they will not be included in the sample (8.02 percent). Then, we split the LD children who took the regular test, the EBD kids who took the adapted test, and the EBD students who took the routine test into four groups. Difficulty, impairment, and outcome sample sizes are presented in Table 1. Instructors in the same impairment group who passed the new exam worked with these students less frequently than those who had taken and failed the average assessment or held multiple certifications.

### *3.2. Variables*

At the end of each grade, NC Math and ELA assessments evaluated pupils' academic progress. Respectable reliability estimates were attained for the common ELA and math tests. IEP teams found that pupils could not show mastery of grade-level skills on the regular exam. Thus, those students took the modified examinations. The altered test was provided to students who required more immediate academic assistance.

### *3.3. Main predictors*

Teacher certification status and certification subject area were included in the administrative files. Teachers in North Carolina become certified in special education (SE) by passing a licensing exam, completing the required courses, and

participating in fieldwork. A teacher had two qualifications if they held certification in either SE or primary education (PE) and a certificate in at least one subject area. After receiving their initial certification, teachers in North Carolina can pass a licensure exam to get a certificate in other subject areas. These instructors come into two categories: those who passed the exam for the other certification and already held a franchise in one place, and those who finished teacher preparation programs in both SE and the other field to obtain their licenses. Passing an exam is all it took for a small fraction of the sample's educators to become dually certified. Disaggregating the dual-certification type led to small cell sizes, wherein just 2.11 percent of pupils were taught by teachers who had earned their licenses via examination.

### *3.4. Control variables*

The student's IEP status, whether or not they received FRL, whether or not they were labelled as ELL or gifted, whether or not they had taken two or more math or reading classes, whether or not they had changed schools, and so on are some of these indicators. Other indicators include the student's race and ethnicity, gender, prior math score, last year's ELA score, and IEP status. Characteristics of their peers included gender, race, ethnicity, language proficiency, socioeconomic status, and eligibility for subsidized or free meals. In addition, they varied the size of the classes to see what would happen. It featured signs from the model for the instructor's years of experience if the instructor was uncertified or just held a provisional teaching license, and whether the instructor had an alternative certification.

### *3.5. Analyses*

According to Feng and Sass (2013), they adjusted the relative importance of each student's peers and teachers based on the number of math and English language arts teachers they had in a given school year. Three separate regression analyses were performed on each disability by exam samples. An initial ordinary least squares (OLS) regression model was created for each topic, factoring in variables such as certification indicators, student characteristics, classroom characteristics, instructor characteristics, and school characteristics. For each academic year and grade, particular outcomes were predetermined. Our method excluded any confounding variables and identified the precise achievement gap between SWDs for a specific quality taught by a SE or dual certification teacher and those taught by a general certification teacher over an academic year. Models with school-fixed effects were built after accounting for school-level variables. Due to the average discrepancy in achievement between these subgroups, researchers compared teachers with General Education Qualifications (SEQ) in the same school to those with SE or DC. Because differences in school leadership, culture, expectations, and school-wide behaviour systems are consistent over time, these factors are not included in analyses of school-fixed effects. Third, a model was developed employing controls for classroom, instructor, and school variables and fixed effects for the students. This method investigates whether students' math and English language arts achievement differ between the years a SE or DC teacher taught them and the years they were led by a GET after adjusting for contextual factors.

**Table 1** Dependent and independent variables are summarized.

| | **Emotional/behavioural disorders** | | | | **Learning disabilities** | | | |
|---|---|---|---|---|---|---|---|---|
| **Variables Independent** | **ELA** | | **Math** | | **ELA** | | **Math** | |
| **variables** | **Reg** | **Mod** | **Reg** | **Mod** | **Reg** | **Mod** | **Reg** | **Mod** |
| % GE cert. | 79.603 | 52.774 | 80.615 | 54.325 | 88.878 | 70.965 | 91.402 | 62.523 |
| Obs. | 4,573 | 1,121 | 4,918 | 965 | 65,963 | 16,568 | 78,226 | 10,196 |
| % Dual cert. | 11.734 | 27.671 | 12.168 | 28.991 | 7.923 | 20.281 | 6.517 | 26.062 |
| % SPED cert. | 7.197 | 18.425 | 6.383 | 15.754 | 2.062 | 7.706 | 1.373 | 7.416 |
| Dependent variables | | | | | | | | |
| Avg. math score (SD) | - | - | -0.881 (0.903) | −0.082 (0.954) | - | - | −0.781 (0.835) | 0.197 (0.905) |
| Avg. ELA score (SD) | −0.764 (0.987) | −0.096 (0.931) | - | - | −0.946 (0.905) | 0.007 (0.965) | - | - |

## 4. Results

For each handicap, test type, and topic, table 2 displays OLS model findings, whereas table 3 displays results from the school fixed effects model and the student fixed effects model. Because students take the assessments at different points in time during the lifespan of the investigation, sample sizes fluctuate subject by subject and across impairment groups. In most samples, there was disagreement between the OLS estimates, the student fixed effects estimates, and the school updated effects estimates. For students with LD who took the revised assessment, the initial negative correlations between SEC and DC and ELA outcomes were 0.09 SD and 0.07 SD, respectively, in the student-appointed effect models. After being adjusted for multiple comparisons, these associations lost statistical significance, dropping to 0.04 SD and 0.03 SD, respectively. There should be more uniformity in the application of this design. There was no statistically significant link between having a dual-certified instructor and lower ELA performance on the revised exam EBD students took in a school setting, as measured by

either the OLS or the student fixed effect models. Differences in estimated associations between certification and academic performance can be seen in the model coefficients, indicating that different approaches were used to account for unmeasured time-invariant factors.

**Table 2** Learning Disabilities: Student Outcomes.

| | Modified assessment | | | Regular assessment | | |
|---|---|---|---|---|---|---|
| **Subject area** | **OLS** | **School FE** | **Student FE** | **OLS** | **School FE** | **Student FE** |
| Math | | | | | | |
| Dual | −.115*** | −.162 | −.012 | −.008 (.021) | −.017 | .013 |
| | (.086) | (.028) | (.044) | | (.022) | (.025) |
| SPED | −.152 *** | −.108* | −.048 | −.057*** | −.051*** | .005 |
| | (.108) | (.112) | (.032) | (.008) | (.011) | (.0011) |
| $R^2$ | .240 | 242 | .009 | .519 | .509 | .008 |
| ELA | | | | | | |
| Dual | −.074*** | −.108*** | −.032 | .032** | −.026 | .029 |
| | (.022) | (.026) | (.025) | (.011) | (.013) | (.012) |
| SPED | −.095** | −.091* | −.041 | −.034** | −.038 | .013 |
| | (.031) | (.037) | (.035) | (.020) | (.023) | (.023) |
| $R^2$ | .795 | .316 | .001 | .633 | 507 | 001 |

Learning disorders, often known as learning disabilities, limit a person's ability to acquire, process, or apply knowledge successfully. These impairments can affect various learning skills, including reading, writing, math, and thinking. It's crucial to understand that learning difficulties reflect a person's cognitive processing skills in a particular area more than intelligence. Regular and modified assessment is the two areas of linear disability. In Figure 1, the learner disabilities in (a) ELA and (b) math are regularly assessed.

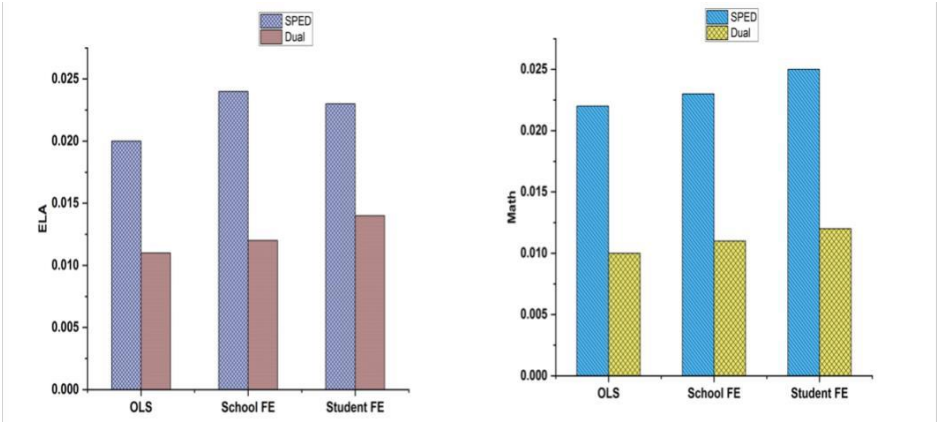


**Figure 1** Regular assessment of Learner Disabilities (a) ELA and (b) Math.

Figure 2 shows the modified assessment of LD. Regular evaluation of their LD is essential for people with LD to be recognized and comprehend the unique difficulties they confront. To successfully address their requirements, it aids in selecting the proper interventions and support techniques. A modified assessment is a variation of an assessment or evaluation process that has been altered or personalized. It entails making precise adjustments to the assessment method, structure, or content to match the needs or conditions of the people or groups being assessed.

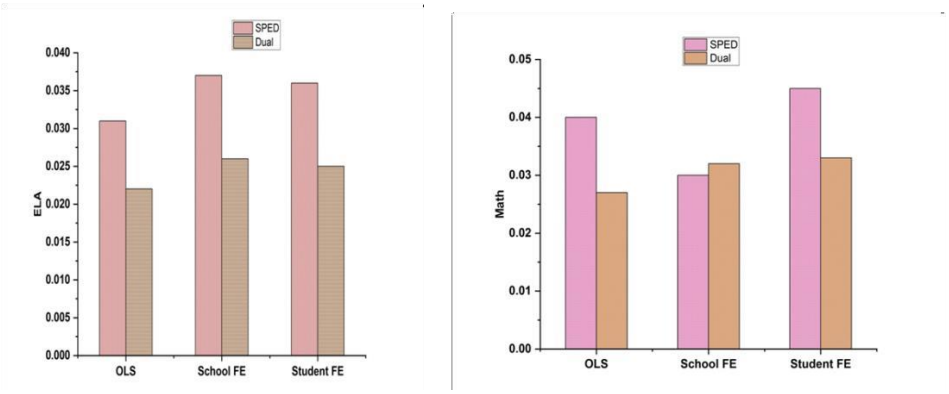


**Figure 2** Modified assessment of Learner Disabilities (a) ELA (b) Math.

Students with emotional/behavioural issues are depicted in Figure 3. Pupils with emotional illnesses experience more significant personal and academic difficulties than normal pupils. Anxiety, depression, and post-traumatic stress disorder (PTSD) are just a few ailments that fall under emotional disorders. These conditions can significantly impair students' capacity to study, control their emotions, and communicate with peers and teachers. The Modified Assessment of Emotional and Behavioural Disorders is depicted in Figure 4 as (a) Math and (b) ELA.

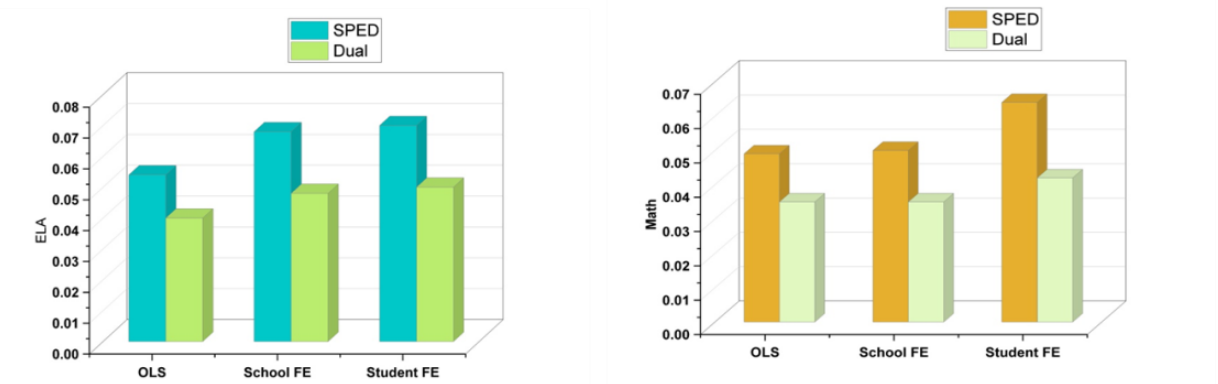


**Figure 3** Regular assessment of Emotional and behavioural disorders (a) ELA and (b) Math.

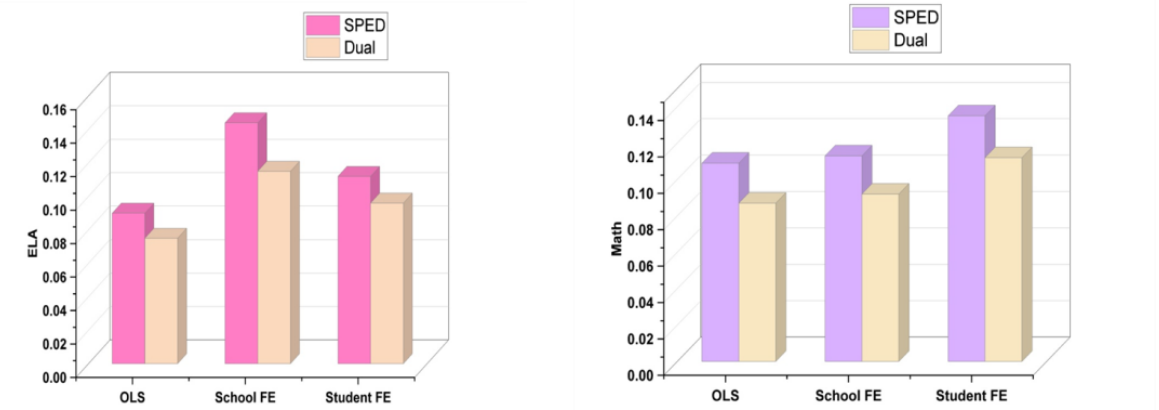


**Figure 4** Modified assessments of Emotional and behavioural disorders (a) ELA (b) Math.

**Table 3** Emotional and behavioural disorders in students.

| | Modified assessment | | | Regular assessment | | |
|---|---|---|---|---|---|---|
| **Subject area** | **OLS** | **School FE** | **Student FE** | **OLS** | **School FE** | **Student FE** |
| Math | | | | | | |
| Dual | −.138 (.086) | −.162 (0.091) | −.003 (0.111) | −.005 (.032) | −.015 (.034) | .005 (.041) |
| SPED | −.191 (.106) | −.226* (.112) | −.272** (.135) | −.038 (.047) | −.041 (.048) | .005 (.063) |
| $R^2$ | 214 | .237 | .011 | .511 | .516 | 001 |
| ELA | | | | | | |
| Dual | −.075 (.075) | −.322* (.115) | −.126 (.094) | .014 (.037) | −.020 (.046) | .051 (.048) |
| SPED | .024 (0.088) | −.257 (0.142) | −.002 (.111) | −0.037 (.053) | −.080 (.068) | .131 (.066) |
| $R^2$ | .295 | .225 | .018 | .508 | 487 | 001 |

Data are shown in Tables 2 and 3 comparing the average development of children taught by dual-certified teachers and certified SET to students taught by certified GET with the same levels of training and experience.

### *4.1. Comparing General Education to Dual Certification Validation for Special Education Teachers*

Teachers holding dual and GE degrees helped LD children do better on the standardized ELA test. In contrast to academics or staff, students are the focus of this differentiation. Children with LD who took classes from teachers with special education (SE) and general education (GE) credentials performed 0.03 SD worse on the ELA test than pupils who took lessons from teachers who only had GECs. On the ELA test, students with learning disabilities at the same school who took

ELA classes from teachers with dual certifications performed 0.03 SD poorer than students whose ELA instructors had degrees in accessible education. Students with learning disabilities who took the test following its modification and were instructed by teachers with GEC performed better than those who took it following its change and were led by teachers with dual or SEQ. In comparison to teachers with merely a current teaching certificate, individuals with dual or SE credentials did not improve their pupils' performance on the modified evaluation. Even in mathematics, a pattern can be found.

### *4.2. Certification in Special Education vs. Dual Certification*

After running the student fixed effects models, we used post hoc analyses to compare teachers with dual and SEC, controlling for factors such as the teachers' experience, education, and the demographics of their classrooms and students. Students with LD who teachers with SE or DC instructed did not see a decline in their ability in English language arts. Students with EBD performed 0.26 SD worse on the modified arithmetic assessment when required by a teacher with an SEC than students taught by a teacher with dual certification.

## 5. Discussion

Faculty at SWD come from a wide variety of academic backgrounds. Despite the widespread belief that SET who have earned accreditation have received high-quality training, very few researchers have investigated whether or not this belief is borne out in actual classroom results for students of varied disabilities and intelligence levels. Additionally, they looked into whether or not students with LD and EBD performed better whether taught by SE, dual, or GCT. This study contributes to the body of research by investigating dual certification and utilizing a sizable dataset that enables the disaggregation of effects according to educational achievement and handicap status. The results demonstrate that most student groups' academic performance was generally unaffected by the SPET, dual, or GEC. This is after considering variations amongst schools, instructors, and students. A few substantial deviations from these conclusions occurred.

Both high performers with LD and low achievers with EBD benefited from having dual-degree instructors. These findings provide fresh insight into the relationship between certification and SWD academic achievement, identify which kids benefit most from teachers with particular qualifications, and raise additional concerns regarding the usefulness of using certification as a stand-in for competency in the classroom. Students with learning disabilities who completed the regular ELA exam showed a substantial correlation between dual certification and their performance, similar to the one discovered by Feng and Sass between SEC and student outcomes. Student sample sizes, modelling choices, and the precise meaning of certification affect how strongly certification is linked to SWD academic achievement. This research suggests that some students would benefit from having teachers with experiences outside of SE.

Meanwhile, few states mandate that educators have DC. Students with LD who took the standardized test performed better in ELA when instructed by a teacher with dual certification rather than a teacher with only a GEC. When there are many students with disabilities (SWDs) in the class, it might be difficult for teachers to collect accurate data, especially if the classes are small or if the students constantly switch between various types of evaluations. Another limitation of teacher human capital is the need for such hiring standards. Education specialists who work with kids with LD and EBD urgently need a more thorough study on reliable indicators of instruction quality.

## 6. Conclusion

There are a few things to remember when trying to make sense of these results. This study addresses a gap in the literature by drawing attention to the challenges associated with using administrative datasets like the one employed here to learn more about the critical factors that influence a teacher with dual certification in SE and GE. A teacher's ability to give high-quality instruction may be impacted by how services are provided, the climate or educational standards of the school, or the quantity of time they spend teaching confident youngsters. School fixed effects models can help fill in some gaps, but they still need to include enough details on how things like laws, how teachers educate in the classroom, and improvements in student learning relate to one another. Finding out if certification influences SWD outcomes and if school-specific characteristics moderate this relationship are critical research questions that can only be answered by large-scale data gathering.

Furthermore, these numbers only represent one state with its unique set of rules regarding licensing. Results may not indicate how individuals with disabilities who have completed a unique education program (SEP) fare in other settings. It is recommended to rerun this experiment using new data sets. Despite these limitations, the results demonstrate the need for additional study of dual certification, classroom settings, and methods for locating outstanding educators. They also wonder if a credential in SE is necessarily an indicator of a good teacher.

## Ethical considerations

Not applicable.

## Declaration of interest

The authors declare no conflicts of interest.

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Examining through interviews parent advocate dyad perceptions of special education representation

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**Abstract** The study emphasizes the necessity of investigating the special education advocate process, especially in light of academic and growth results for children. It adds that many parents need advocates to get special education services for their disabled kids, but this field is yet mostly untapped. By interviewing parent-advocate pairs, the research's goal is to examine the special education advocacy procedure. The study used qualitative methods of study, specifically interviewing nine “parent-advocate “pairs. These pairs were chosen to offer a variety of points of view and knowledge about the advocacy for SE. In-depth information about the advocating process, the reactions of schools, and the perceived impact on child and family success were to be gathered through the interviews. The data from the interviews were analysed using thematic analysis to find common trends and themes. The study's conclusions showed that family and “advocates” shared a common understanding of the SE advocating system. Participants stated the participation of an “advocate” was generally welcomed by schools. It was also observed that some schools acted combatively and showed astonishment at the appearance of an “advocate”. Parents and “advocates” agreed that advocacy had a beneficial impact on children and families' results, despite differing opinions from schools. The summary did not precisely state how advocacy specifically affected these results. The study emphasizes the significance of the SE advocating method and its alleged favourable effects on success for children and families. The results show that although there have been instances of hostile responses, schools frequently react favourably to “advocates”. However, both “advocates” and children thought that advocacy had positive results. These findings highlight the need for additional study and the consequences for policy and practice. The consequences are probably expanded upon in the following section, but the overview does not include the specifics.

**Keywords**: school, families, children, interview, special education

## 1. Introduction

Confidence is essential for parents advocating for their disabled children in order to secure resources. According to the concept of self-efficacy, a person can do an action and, in a challenging situation, actually carried off that conduct. The concept of empowerment is particularly pertinent to advocacy in the context of theory of self-efficacy (Mathews et al 2023). According to, empowerment takes place in three contexts: the political (i.e., societal change), connections (i.e., the capacity to sway others), and personal (i.e., one's own emotions of self-worth). Groups that have historically received inadequate services, such as parents of disabled children, are susceptible to disempowerment in all three contexts (Burke et al 2019) Parents of young people with impairments, in particular, encounter disempowerment when advocating for their own kid, another family, or structural improvements in personal, interpersonal, and social settings. Additionally, there are other structural obstacles that prevent parent involvement and empowerment (i.e., obstacles that affect almost all families). Examples include the power imbalance between parents and schools and the median level of procedural protections. People may resort to SE “advocates” as a consequence of societal hurdles. A person who “advocates” on someone else's or a cause's behalf is known as an “advocate” (Potchter et al 2020). SE advocacy instruction have become more widespread in order to create “advocates”. Research on advocacy trainings has so far indicated that these programs may boost knowledge, empowerment. Therefore, the majority of investigation has been done exclusively with “advocates”, not the families they serve, because the majority of studies have concentrated solely on the effect of “advocacy” training on the “advocate” (Wood et al 2022). However, the goal of “advocacy” is to enhance conditions for family of disabled children. Therefore, this study's goal was to investigate the “advocacy” manage in “advocate-family” pairs, as well as the impact of advocating.

The rest of this paper are as follow: part 2 literature review Part 3 contains the proposed method explained. Part 4 includes the results and analysis. While Part 5 discusses the conclusions.

## 2. Literature Review

The study expands our knowledge of the role that relationship diagnosis and family assessments can have in both the avoidance and management of psychotic disorders in family (Roca et al 2020). A control group was chosen by deliberate no probabilistic choosing in a quasi-experimental design. The outcomes enabled us to emphasize the need of employing family evaluation techniques while conducting family assessments and treatments (Asbury et al 2021). In accordance with the most current suggestions in the field of mental disorders, they believe that these efforts will immediately result in recovery for both patients and their families. The subjective phenomenology study's goal was to investigate how school psychologists in Arizona perceived the requirements for SE status under ED as well as assessment techniques (Engebrethsen et al 2020). Three school psychologists who are active members of the Arizona Association of School Psychologists (AASP) and currently working in practice participated in the research. The results showed that assessment techniques and comprehension of the eligibility criteria for ED as they are now stated in IDEA are inconsistent. Five SE teachers and five parents of children with autism spectrum disorder ASD were surveyed for the study's data. The report suggests that school districts organize events expressly for parents of autistic students and carry out professional learning that provides teachers with evidence-based techniques for fostering collaboration with families in a public-school setting (White et al 2021). The findings of the study were utilized to compare and contrast the perspectives of interactions between SE instructors and parents of children with ASD, and to suggest ways to make corrections. They aimed to test the idea that, among parents of noncomplex children with special health care needs (CSHCN) and children without such needs (non-CSHCN), parents of CMC would have the highest probability of having poor or fair psychological conditions by Bayer et al (2021). Parents of children with CMC were most likely to report having poor or fair mental health, having trouble managing the responsibilities of parenting, and not recognizing where to turn for assistance in their local community when they ran into problems among families of kids with all degrees of child medical complication (Cooc et al 2019). In conversations with their children's speech-language pathologists (SLPs), one who identified as Mexican American and the other who identified as White American, two bilingual (Spanish/English) Latina mothers with children on the autism spectrum were examined for their cultural viewpoints and requires by Esquilín (Nieves et al 2023). Increased “advocate” abilities for the moms were demonstrated in post-interview written reflections, and improved communication style understanding for the SLPs was demonstrated. The study's goal was to comprehend adult sibling relationships from the viewpoints of both sibling groups—those with and without individuals with intellectual and developmental (IDD). They investigated eight mature sibling dyads' viewpoints using dyadic interview (Rossetti et al 2023). In the United States, the study was carried out. Themes inside and across dyads were found utilizing continuous comparison and cross-case analysis of the information. According to the study, sibling connections and settings are perceived similarly by people with IDD and siblings. The essay starts out by providing a brief overview of the Family as Faculty (FAF) concept, its execution in SE teacher preparation programs, and the manner in which it has been consciously rethought to incorporate historically excluded and minority families Santamaria (Graff et al 2020). As a long-term initiative, FAF might support the demolition of deficit-driven pre-service educator views of families and the development of critical conscience geared toward equitable transformation for both kids and their parents (Hurwitz et al 2022). For us, it seems sense to assume that the likelihood of transformative change and long-lasting effects increases with the number of essential and entire connections that take place (Buren et al., 2020). The meta-synthesis gathered opinions on home-school partnerships from families of disabled children in underrepresented communities The majority of the study on the cooperative experiences of families of disabled children from non-dominant cultures has used qualitative techniques. Critical race theory-based research on social equivalency has a transformative ability to use the stories of parents from underrepresented populations to bring about systemic as well as structural change in the field of SE.

## 3. Methodology

### *3.1. Participants*

Nine advocacy dyads and 6 parents of disabled children who partnered with an “advocate” made up the participants. The Voluntary Advocacy Scheme (VAS) education was finished by the “advocates” between 2005 and 2022. The eligibility requirements for the “advocates” were as follows: (a) they had to be at least 18 years old; (b) they had completed the (VAS) in Illinois or Tennessee; and (c) they had to have fought for the participation in the study of the parents of a person with disabilities. Unsurprisingly, one (VAS) alumnus working for the families Centre for Training and Information (PTI) and was a “self-advocate”. Being older than 18, having laboured with a (VAS) graduates, and having a kid with disabilities were the eligibility criteria for both parents.

### *3.2. Recruitment*

By emailing VAS students who had previously stated in another study that they had actively "advocated" for family of people with impairments, they were able to recruit people for the current investigation. An email invitation was given to 18 VAS grads explicitly. Due to timing issues (e.g., one student had moved to a different state and had to now plan the conversation; another school was finishing graduate school and had no time to arrange the interview), five of the participants decided not to take part in the study. To take part in the study, interested VAS grads called the second author; each VAS student submitted the name and contact details of the relatives they had supported. The second author made contact with the family to invite them to take part in the study. Every family that was contacted consented to take part in the study. One US$10 gift card was given to each participant for finishing the interview, and another US$10 gift card was given to each participation for performing the member's checks. Table 1. Participant Demographics to take part in the study, interested VAS grads called the second author; each VAS student submitted the name and contact details of the relatives they had supported. The second author made contact with the family to invite them to take part in the study. Every family that was contacted consented to take part in the study. One US$10 gift card was given to each participant for finishing the interview, and another US$10 gift card was given to each participation for performing the member's checks.

**Table 1** Participant Demographics to take part in the study.

| No | Dyad | Advocate/Parent | Gender | State | Education | Race | Child's disability | Child's age |
|---|---|---|---|---|---|---|---|---|
| 1 | Matie | Advocate | Female | Illinois | High school | Latina | Autism Spectrum Disorder | 9,20 |
| 1 | Irma | Parent | Female | Illinois | High school | Latina | Autism Spectrum Disorder | 14 |
| 2 | Shane | Advocate | Male | Illinois | Graduate school | White | Autism Spectrum Disorder | 19 |
| 2 | Mary | Parent | Female | Illinois | High school | White | Autism Spectrum Disorder | 10 |
| 3 | Janet | Advocate | Female | Tennessee | Graduate school | White | Learning Disability | 12 |
| 3 | Allison | Parent | Female | Tennessee | College | White | Autism Spectrum Disorder | 9 |
| 4 | Jane | Advocate | Female | Tennessee | Graduate school | White | Autism Spectrum Disorder | 21 |
| 4 | Megan | Parent | Female | Tennessee | College | White | Specific learning disability/Hearing Impairment | 11 |
| 5 | Linda | Advocate | Female | Tennessee | Some school | Latina | Visual Impairment | 7 |
| 5 | Maharba | Parent | Female | Tennessee | Some high school | Latina | Autism Spectrum Disorder | 7,12 |
| 6 | Eileen | Advocate | Female | Illinois | High school | White | Learning Disability | 8,12,17 |
| 6 | Susie | Parent | Female | Illinois | College | White | Deaf | 8 |
| 7 | Anita | Advocate | Female | Tennessee | Graduate school | White | Autism Spectrum Disorder | 19 |
| 7 | Sarah | Parent | Female | Tennessee | College | White | Autism Spectrum Disorder | 17,15 |
| 8 | Kristine | Advocate | Female | Illinois | Graduate school | White | Intellectual Disability | 7,17 |
| 8 | Pam | Parent | Female | Illinois | College | White | Autism Spectrum Disorder | 16 |

*3.3. The VAS*

Through a 33-hour course of study, the VAS equips participants to "advocate" for SE. Irrespective of their nation, everyone who took part in the VAS received the same information. Individuals gained knowledge about non-confrontational advocacy techniques and SE policies during the VAS. IEPs, assessments, based on research actions, extra school year offerings, behavioural strategies for intervention (BIPs) and control, formal conflict settlement (i.e., Due process and mediation), and the most restrictive setting were some of the subjects covered by SE policies. Examining a school students record, composing letters to the institution, arranging conferences with educational institutions, offering impact (i.e., emotional) support to family during IEP meetings, and informing families of their special study rights were some advocacy techniques.

*3.4. Procedures*

Using dyadic interviews, the study was able to analyse “advocate-parent” encounters and create an integrated story of the dyad. The VAS student and the family they supported were first interviewed on a private basis. The VAS graduate and his or her family were then interviewed in a pair. Participants' information was gathered using an information sheet and an interviewing methodology. Demographics were highlighted in the data sheet. The study was intended to create perceptions about advocacy, hence social constructed reality was the epistemological stance. A comprehensive literature review on individuals of people with disabilities as well as advocacy for SE was done in order to establish the speak with regulations. A preliminary protocol was prepared using the studies in the literature and evaluated by 6 families of people with additional disabilities as three specialists in qualitative methods and SE “advocate”. For instance, they added the following query after the review: "What do you wish the “advocate” knew?" The method was then tested out with a family that was strongly supports and an “advocate”. Small adjustments were made to the procedure and demography form as a result of the pilot, such as checking that the possible answers for the demographic inquiries were appropriate. The procedure and the investigation itself had been authorized by an institution review panel after additional adjustments. The conversation the dyad, family, and advocacy followed the same format. The interview's time and date were chosen by the participants. The entire interview process took place over a phone call. According to earlier studies, phone and personal interviews may provide the same outcomes. In order to get patient agreement and establish trust, protocols were observed. For instance, participants were reminded that their participation in the discussions had no bearing on their relationship with the VAS. In order for members to feel confident offering their ideas, procedures were made to protect their identity. As an illustration, every name were changed to pseudonyms. Additionally, the participant names and contact details were kept apart from their interview summaries. The researcher explained herself, the study's objective, and her professional and personal ties to disability and advocacy before the interview even started. The two subsequent researchers performed the interviews; they had both participated in the VAS, so they were comfortable with the material and had built familiarity with those who participated. Between 70 and 110 minutes were spent on each one. Every individual was questioned about every aspect of the process, and they were also subjected to repeated inquiries. The writers collected introspective and detailed notes throughout every conversation. All 32 interviews were taped and verbatim published. To confirm the accuracy of the transcripts for the six Spanish-language interviews, audio recordings were edited, interpreted, then back-translated.

*3.5. Data Analysis*

The research notes and transcriptions of interviews were coded using emerging coding and consistent analysis of comparisons, and extra sources of data (such information sheets) were triangulated. The authors read every transcription separately many times to become comfortable with the information. All text was individually encoded by the writers using a line-by-line method. Every item of information was contrasted to every other piece of information, highlighted, and annotated with a phrase. Each piece of coded language, notwithstanding its size variations, conveyed a single concept. There were 182 codes in total. As an illustration of the outcomes of advocacy, codes for adult assistance (such as signing up for the Medicare waiver and going on receiving support after the age of 18) included treatments like occupational therapy and speech therapy, transport, social stories, adult placement, fresh placement, and inclusive placement service provision. The authors put each code in the codebook once all the information had been coded. They act separately Read the information (i.e., transcribed interviews and field notes) once more and used the codebook to determine whether all the data had been correctly coded and whether any new codes needed to be entered.

In order to decide whether further codes should be provided, the developer particularly addressed the codes and sought consensus. The researchers concentrated on the bigger groups and issues after verifying the coding. The writers especially concentrated on the primary concepts for the procedure of advocacy that exhibited the most effective lobbying strategies used by the public.

For instance, according to the advocacy of effects, codes were divided into these types: increased therapies, boosted referrals, The kid improved, increased resources, improved family-school relationship, enhanced parental “advocacy”, suitable kid task, family and "advocate" keep working together, received adult assistance, enhanced parent autonomy, received augmentative and alternative AAC devices increased the targets through communication, and They looked for trends in information between the coding categories and within the codes. The authors made sure the themes were distinct by carefully going over everything. The following categories, for instance, were included in the subject of better-suited services provided as a result of advocacy: more treatment, greater assets, receiving equipment, and adult services. The authors performed a cross-case examination following the identification of the subjects found in the “Advocate-parent” couples. As a result, the results were first examined inside pairs, and subsequently between pairs. The dyads did not differ in any way from one another. The redundancy of topics shows that data overload was reached with 12 people. Having a background for why an “advocate” is needed, talking to the family, showing empathy for them, empowered them, preparing for IEP sessions, education the family, and offering continuous support were the themes for the advocacy method. The school's reaction to advocacy was characterized by three main themes: Favourable welcome, confrontation, and astonishment. Better services being offered, better school settings, better student outcomes, and improved parent experiences were the main themes for advocacy's results.

*3.6. Reflexivity*

The entire team represented specialists in the subject of impairments, with the exception of the first and third authors who were families of people with impairments. Consequently, their personal and/or professional perspectives might have aided in building connection with those involved. Before every interview, every writer gave a brief overview of her professional and personal history. Additionally, every author had preconceived notions about the undertaking. Each author specifically thought that advocating may be successful in assisting family in receiving the services they require. In order to do that, the authors practiced reflection throughout their work by outlining their observations, values, and views.

*3.7. Validation and Trustworthiness*

By using three different sources, doing a bad investigation, and members' verification, believability and conformability were determined. The triangulation was achieved by using a variety of data sources (such as the advocate and relatives) and data gathering techniques (such as translations and fieldwork records). To see if the replies were identical, for instance, they examined the data from the solo and dynamic surveys. There were no variations noted. In addition to the themes found during the data evaluation, a negative case study was also performed. For instance, we looked over the field notes and transcripts to see if all "advocates" showed up for IEP meetings with family. Due to schedule issues, we discovered that Matie was the only advocate who failed to accompany a family to an IEP meeting. The people involved checked the data after it had been coded (i.e., member checked). To guarantee that the lobbying effort was fully conveyed, a summary of each interviewee's private conversation was delivered to them. According to the responses from all participants, the topics adequately represented their views. The VAS was completed by all of the "advocates", and they all worked with people who are families of disabled children. However, the VAS was finished by the proponents in a number of cohorts and states, including Illinois and Tennessee. Participants, who included parents and supporters, also represented a range of academic and cultural experiences. In order to allow for a variety of conclusions, the entire range of data was incorporated in that investigation.

**4. Findings**

*4.1. The Process of Advocacy*

Having a Situation where an Advocate is required - When they encountered difficulties or had disagreements with the school, all of the participating parents said they contacted an advocate. Mary stated that, for instance, "I became highly concerned about her [my daughter's] development and so I called out to an advocate." Mary especially stated that her child had failed to make academic progress at school and that the institution would not take her worries seriously. She called Shane, a representative, as a result. Allison contacted an "advocate" after citing similar issues with the school (Table 2).

Allison claimed that the school frequently phoned her to bring up her daughter and complained that the child was acting out. According to Allison, the principal was, Allison specifically mentioned that she had issues with the SE a coordinator the teacher, and other assistance providers in addition to the president. Allison specifically mentioned that she had issues with the SE manager, the teacher, and other assistance providers in addition to the principal.

Encountering the family - Every participant agreed that "advocates" interact with families in different ways: by calling them, meeting them one-on-one, and answering their questions.

Conversing on the phone with parents - According to users, activists first called parents to have a phone talk. "Matie", an "advocate and parent" Autism Spectrum Disorder (ASD) of a kid, her paediatrician reportedly routinely referred families to her. Matie claimed, "I just called her [Irma] out of the blue and asked, 'Hey, how are you doing? "After being provided Irma's contact information. How are you guys doing? They conversed for perhaps 50 to 60 minutes. Irma recalled their meeting and said, "They discussed it [advocacy]." My child's autism diagnosis was recently made. I knew absolutely nothing while I was talking to her.

Holding face-to-face meetings - The need of meeting in person early on in the lobbying process was brought up by the participants. After emailing Sarah, Anita, an "advocate" and the mother of a young adult with ASD, confirmed that they had met. One of Sarah's children has attention deficit hyperactivity disorder (ADHD) and another has ASD. The face-to-face sessions with Anita were appreciated by Sarah, who stated: "My neighbour gave me her phone number, and I emailed her and explained what I was going to be through. She immediately replied to my message and said, "When can they meet?" They subsequently met.

Answering parent's questions - Families' questions were addressed by the "advocate", according to members Shane, a retired SE director and step-father of a child with ASD, reported that during his initial contact with Mary, the parent of a child with ASD, he was "... responding concerns, giving Mary instructions." Mary also stated that Shane responded to her inquiries by saying, "I felt like he could give me an unbiased, you know, opinion." Participants were able to build relationships with families by talking to them and start a process of advocacy.

**Table 2** Process, Reaction, and Advocacy Results.

| Themes | Sample quote |
|---|---|
| Advocacy process | |
| Meeting the family | "I called Matie and we talked about it—my daughter had just received a diagnosis of autism," Irma said in her report. I was completely ignorant. Services were being provided in the home for my daughter. When I called Matie as they were about to end, she informed me that my kid must continue with speech therapy and occupational therapy. |
| Context for needing an advocate | In her report, Megan stated, "I started working with the advocate on a communication device that the district had refused [to provide]." |
| Empowering the family | Documentation is crucial, and Jane stressed its significance: "I encouraged her to try to only communicate in formats that we can document. Megan was really good about doing that." Megan claimed that Jane taught her how to record her interactions with the school. According to Megan, "She [Jane] was meticulous in coming up with documents and making timelines." |
| Empathizing with the family | According to Allison, a parent of an ASD child, "I am really just a beginner at learning SPED law and how to raise two children with special needs... really understanding the disability, understanding what the IEP needs to look like, and understanding what I need to do every day." Allison summarised the assistance she received from her advocate. She has simply been telling me and demonstrating for me. |
| Educating the family | A supporter named Janet stated, "I want to teach Allison about the explanation of a goal. She will learn all about the IEP process from me as well as about her current levels. |
| Preparing for IEP meetings | Susie stated "Eileen has attended at least half of my IEP meetings since I first met her. She offers suggestions and raises issues that are helpful. She is aware of all relevant laws, citations, and expectations on what is and is not permitted. She is also familiar with my child. |
| School's response to advocate Positive | Shane, an advocate, started speaking up for Mary as she was discussing mediation with the school: "The school district staff made me feel very welcome." The family that Shane battled for was represented by Mary, who said, "I think they [the school] responded well to [to Shane]." |
| Providing ongoing support | I won't attend an IEP without Janet [advocate], said Megan, the mom of a child with a handicap. I hope to employ her once again. |
| Surprised results of advocacy Increased appropriate services | According to Allison, Janet's lobbying helped students make more progress both now and in the future since they were receiving the supports they required. They are benefiting from better conditions at home and school as a result of activism, which led to FAPE. A future is the outcome. Their future is bright. Previously, it was unclear. According to Janet, Allison's child was able to receive the necessary reading programmes because to her advocacy: "... getting him programs he needed." |
| Confrontational | A mother named Megan said, "Well, when we bring someone in, they bring their lawyer." Jane added that the institution's reaction to her presence was "resistant." According to Sarah, the school occasionally—maybe once or twice—became a little defensive in response to Anita's presence. They must have been on watch. |
| Improved student progress | A mother named Megan said, "Well, when we bring someone in, they bring their lawyer." Jane added that the institution's reaction to her presence was "resistant." According to Sarah, the school occasionally—maybe once or twice—became a little defensive in response to Anita's presence. They must have been on watch. |
| Improved parent experience | Maharba stated that she was able to interact with the instructor and express her requests better as a result of Linda's advocacy: "... to be able to communicate with the teacher and to give her our requests." According to Linda, "I'm teaching her to advocate for herself because... she can do it." |
| Improved school experience | In addition to obtaining a re-evaluation, Kristine noted that they were able to raise Pam's child's goals: "The results of it were that we adjusted some of the goals." Pam wrote measurable, specific goals for discussion with the school, according to Kristine's account of the dyadic interview. Pam stated, "We came up with some really great objectives! Imagine being able to ride the bus to the supermarket, buy three things, and return home with the right amount of change. |

Having compassion for the Family - The advocates, according to the people involved, were themselves families of disabled children. People felt that "advocates" could relate to family because they had personal experience raising disabled children.

Sharing own experience - Relating personal experience. Respondents said that "advocates" used personal stories about their own disabilities to establish a rapport of confidence with family. Eileen, Susie's "advocate", "had more of an intimate understanding of the districts and all things as well as personal experiences, "According to Susie, a parent of a deaf child. "I've been here for 16 years... she has similar circumstances and problems, and they kind of related through them over a year ago," said "Eileen, the parent of a kid" with apraxia.

Being supportive - Relating personal experience. Respondents said that "advocates" used intimate details about their own disabilities to establish a rapport of confidence with family. Eileen, Susie's "advocate", "had more of an intimate understanding of the districts and all things as well as personal experiences," according to Susie, a parent of a deaf child. "I've been here for 16 years... she has similar circumstances and problems, and they kind of related through them over an entire year ago," said Eileen, the parent of a kid with apraxia.

Empowering the family - Participants said that “advocates” increased parent-school interaction, encouraged the family to keep records of school communication, and encouraged the family to ask queries of the school to enable families to be active IEP teammates.

Encouraging the family to ask questions - Advocates allegedly urged parents to question the school, particularly at IEP sessions, according to attendees. “The advocate”, “Kristine”, who was also the mom of a child with Down syndrome, met with the family before the IEP conference and urged them to prepare questions for the IEP meeting. They had to sort of prioritize when they attended Pam's daughter's IEP meeting in April, according to “Kristine”, who said, "So, what do they want to accomplish here?" Pam, a mother of two special needs kids, recalled that before the IEP meeting, she would consult Kristine on the right issues to bring up. What do you think about that?" Pam questioned Kristine. Can I have the please? Could I have that please?

Increasing the parent's involvement in school communications - “Advocates” reportedly made an effort to improve parent-school interaction, according to respondents. Irma, a mom of an ASD child, noted that Matie, who serves as her “advocate” has improved her interaction with the school. Irma said her kid had a hard time making the shift to and from school. In addition to suggesting that Irma ask for transport, Matie also advised Irma to a social invitation narrative to help her daughter adjust to going from home to school. Irma asserted that implementing these tactics, "When I arrived [at the school], I already knew how to talk to them." Matie also reported. The institution agreed to offer transport and a social narrative for Irma's child after exchanging multiple emails.

Encouraging the family to document - Counsel assisted family in submitting complaints to the school in order to educate and empower family. In order to document interactions with the school, Janet (the advocate) worked along with “Allison, the mother of a child” with ASD. Allison was appreciative of Janet's assistance in instructing her on how to mail letters to the school. The most effective tactics, according to Allison, "were letter writing, ensuring people knew I was making demands, and making sure people understood," she said.

Getting ready for IEP meetings - Participants addressed issues related to the IEP and attended IEP meetings as two approaches to prepare family for meetings with the IEP.

Addressing IEP-related concerns - Sarah stated that she met with Anita (the advocate) to review the IEP before IEP meetings. Sarah, for instance, stated that she wants her son to take particular subjects in order for him to earn a conventional education credential. Sarah particularly wished her kid to take an environmental subject (instead of a chemistry class that primarily relied on math) because he had a math-related impairment. The college declined. Sarah wrote. He has some difficulties with learning, so they [the school] only had to conduct the necessary tests and then make the legally permissible alterations, which is what they did, according to Anita, who addressed Sarah's worries.

IEP meetings attendance - Participants said that by showing up at IEP meetings, “advocates” encouraged family. Mary expressed her appreciation for Shane's presence at the IEP meeting, saying, "It's just mostly having someone there because it's kind of stressful so getting somebody who actually opens up helps a whole lot." Shane recounted addressing queries at the IEP discussion with Mary.

Educating the family - Participants said that through clarifying services, alerting parents of their rights, and disseminating details of trainings, “advocates” informed parents.

Explaining services - Participants stated that parents were informed about services via “advocates”. Allison was not aware that her daughter had a BIP at the time Janet (the advocate) described to her what a BIP was for. Janet noticed the BIP after looking over Allison's IEP and told Allison what it was made of and what it was for. She also assisted Allison as she collaborated with the school to raise the BIP's standard. The outcome, according to Janet, is that I was able to persuade Allison to recognize the importance of a very specific behaviours plan for her child, and that a behaviour plan that is specific also entails consistency. Allison observed the same.

Parent rights -Respondents stated that parents were informed of their rights by activists. "I assisted her say like 'Hey, that's not true, you do have to give permission, you do have to sign stuff," Eileen (an advocate) said of helping Susie, a child who was uninformed of her duties. Advocates claimed that they were able to empower parents by explaining to them their duties in the SE process and by educating them on important concepts. Similar to Susie, "She [Ellen] gave me a few things like that too," she noted. She made me many offers of articles and other items.

Distributing details on parent trainings - Participants said that “advocates” discussed training details with them. Maharba (parent) revealed that her “advocate”, Linda, who worked as well at the PTI, informed her about classes there. The training Linda conducted to explain the IEP meeting, according to Maharba, was the most helpful item for her. Regarding numerous sessions, Linda reportedly said to Maharba: "They have the meeting that, you know, that's stuff that they ask families to go to. Live workshops are offered. On our YouTube channel, they provide video meetings. Participants enabled families to learn more about their liberties by pointing them in the direction of resources and guidance.

Providing ongoing support - The “advocate” reportedly assisted the family continuously, according to the members. For instance, “Linda” and “Maharba” stated that Linda had been ‘Maharb's” “advocate” for the previous ten years (from preschool to middle school). “Maharba” said, "Linda additionally stated that she was going to stay an “advocate” for Maharba's son." Linda was asked if she would be continuing to be her “advocate”. But Linda also underlined the value of

“Maharba” developing her own advocacy skills: "I am helping her to develop her own advocacy skills because that is extremely crucial. You know, there are a lot of disadvantages for many Latino families. Linda also mentioned that institutional barriers make it challenging for Latino families to mobilize. Maharba’s need to learn how to speak up for self: "I am training her to learn how to speak up for herself because it is really essential. You know, there are a lot of disadvantages for many Latino families. Linda also mentioned that institutional barriers make it challenging for Latino families to organize.

*4.2. The School’s Response to Advocacy*

Favourable response - The majority of interviewees stated that the “advocate” received a favourable response from the institution. An “advocate” named Linda, for instance, stated that "The school was always receptive..." to her presence. “The school reacted very well because she [Linda]—it was not her first IEP meeting that she visited there," said Maharba (parent). The school was already familiar with her art. Due to the school's familiarity with the advocacy, according to other duos (such as Janet and Allison), the school was more accommodating.

Confrontational - Some participants reported that schools were unfriendly (hostile in the sense of disrespectful, unhappy). Pam and “advocate” Kristine attended an IEP meeting that, in Kristine's opinion, was rather heated. Right away, they were pretty aggressive, and I wish I could have handled it better. Pam said she didn't get along with the education team. She added that during earlier IEP meetings, Kristine had encountered antagonistic conduct from the SP director. Pam remarked, "I feel like Matthew [the district representative] was pretty nasty with her [Kristine] for some reason. Two additional pairs complained that the education was hostile. Sarah, the parent, had a tough relationship with the education, according to the other couple, Anita and Sarah. Due to Megan, the parent, being a passionate ally and understanding of her rights, one of the dyads, Megan and Jane, alleged that the education was hostile. However, the pair went on to say that the institution only turned hostile when the parent or “advocate” requested its assistance.

Surprised - Some participants claimed that schools were hostile (i.e., disrespectful, dissatisfied). The IEP meeting Pam and “advocate” “Kristine” attended was quite combative, according to Kristine. They were quite hostile right away, and I wish I could have handled it differently. Pam claimed that she didn't get along with the school squad. She also mentioned that “Kristine” had experienced hostile behaviour from the SP director during previous IEP discussions. Pam remarked, "I feel like Matthew [the district representative] was pretty nasty with her [Kristine] for some reason. Two additional pairs complained that the education was hostile. The other couple, “Anita and Sarah”, revealed that “Sarah”, the parent, had a tense relationship with the education. One of the dyads, Megan and Jane, said that the school was combative because “Megan”, the parent, was an aggressive “advocate” and fluent of her rights. However, the pair also asserted that the institution only turned hostile when the parent or “advocate” requested assistance from it. They were a little shocked when they first met. They may not have truly known how to handle Janet. They (past advocates) were a touch passive, Janet said in response. The school staff members were taken aback.

*4.3. The Effects of Advocacy and Effective Techniques*

Outcome of advocacy - Participants claimed that lobbying resulted in more resources, better school environments, better student outcomes, and better parent relationships.

Expanded appropriate services - Participants claimed that the “advocate” made it feasible for children with disabilities to get the proper help. According to Megan, Jane (the advocate) helped her receive an AAC device from the school: “Jane actually assistance us get the speech gadget”. The school personnel will now be able to contact with her via technology. They got what they wanted. Jane claimed that she supported Megan in requesting the AAC device from the school, despite the difficulty of doing so: "She [Megan] did not mean to just quietly go away. She pushed on, moving forward with determination. She is among those people who never quits up.

Enhanced school performance - Several attendees asserted that “advocacy” led to modified educational outcomes, including relevant evaluations and diplomas, labels for disabilities, and aspirations. Anita said of her efforts on Sarah's behalf, "I think the part where they got the extra examinations that got him the course [i.e., ecology course] that he believed would be the most beneficial for him to graduate—that was probably the best thing I did for them." Sarah added that Anita supported her in her fight for a traditional graduation in addition to helping her win the class: "They worked hard with him to get my child to eventually walk across the platform and not go for his “GED” or for an electronic diploma. They had great difficulty.

Increased academic progress - Participants said that the child made educational progress as a result of advocating. "I feel the greatest thing is and... I pretty much cry each time I speak to them... it's when they informed me that their children is doing more successful," Matie said of how her activism assisted Irma's daughter in improving. Irma stated, "Now that she [my daughter] knows how to write her name and brings a few materials that the educators gave her... and yes, there are a few words [she is reading] and she is doing it [reading]," in a comparable way.

Improved parent experience - Parents' advocacy, according to participants, had a positive effect. These results included improved family-school ties, improved parental-school communication, increased parental empowerment,

improved family standard of living, and improved SP expertise, to name a few. Yes, Janet is very particular, but I have a big picture, and this is the result is great for the high lifestyle high standard of living for both of my children, Allison remarked. They both live better lives as a result of lobbying, in my opinion. According to Janet, "I think that [the advocacy] lowered her stress".

## 5. Conclusion

In that study, we investigated how advocates' and families' experiences with the SP advocacy method. They discovered three key things. First, the identical advocacy procedure was described by both supporters and family. Second, the research provided insight into how the institution handled advocacy. Third, the outcomes of advocacy appeared to be favourable. Previous studies have shown that child advocacy results in better outcomes. The study had some restrictions. First of all, every “advocate” had successfully finished the VAS, a program for advocacy. Other programs' “advocates” might use an alternative advocacy strategy. Therefore, transferability might only apply to VAS proponents. Second, no data from observations were gathered to support the advocates' and family' allegations. Such information would be beneficial for both comprehending the advocacy process and disseminating the results to a larger advocate organization.

Finally, it is critical to carry out study into the detrimental effects of advocacy. Our study's respondents might have agreed to take part because they had generally good experiences with advocating. Understanding how “advocates” assist the families with disabled children is vital. By exploring the advocacy process from the viewpoints of families of people who have difficulties and their “advocates”, the research adds to the body of knowledge on the subject. This study also implies that advocating for SP may help children and families have good results. It is necessary to conduct more thorough study to determine how advocacy affects student accomplishment.

## Ethical considerations

Not applicable.

## Declaration of interest

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Examining admission and scheduling for Asian American and pacific islander students' special education

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**Abstract** Admission and scheduling for Special Education (SE) are crucial procedures to ensure students with disabilities receive the particular assistance and resources they need to succeed in school. Recent research has questioned these patterns, suggesting that students of colour may be underestimated in programs covered by federal law, even though educational systems in the US need to track the excessive several minority students in SE. Asian Americans and Pacific Islanders (AAPIs) are a population that has historically been underrepresented in special education. They are often left out of these conversations on disproportionality. However, prior research has not looked at the enormous variability in experiences between AAPIs and how the special learning trends can vary between AAPI ethnic groupings. To study the experiences of AAPI students, researchers chose a suburban school area in California. This work is part of a wider district-researcher cooperation aimed at reducing racial inequities in the area's special education services, especially for AAPI students. This research explores further underrepresentation by breaking out participation rates and the timeliness of goods and services for 11 AAPI ethnic groupings over 10 years utilizing longitudinal data on ten cohorts totalling 42,807 kindergarteners from a single school district. The results demonstrate that AAPI students are neglected in special education and obtain services later on than their White peers. Even after taking into consideration student history, degree of acculturation, and fixed influences at school, these patterns persist. The under representation of AAPIs in SE, both overall and across the majority of AAPI ethnic groupings, as discovered in this research, is a warning sign that the system isn't fair to AAPIs. These patterns reflect how AAPI students are becoming marginalized in schools and how difficult it is for them to get treatment for a variety of problems, such as poor academic performance and peer harassment.

**Keywords**: admission, scheduling, special education, Asian Americans and Pacific Islanders

## 1. Introduction

Over the past 45 years, state and federal statistics have clearly shown that students of colour outnumber white students in SE, notably Native American students, and to lesser extent Latino students (Bal et al 2019). Concerned that students of colour and other historically oppressed children would be treated unfairly or forced to attend separate schools when these disparities are conjunctions with worries about the efficiency and lack of opportunity in special education, possibly disability discrimination, including lower instructors' expectations for students with impairments (Cooc 2022). However, several studies have found that these same colour students are underrepresented in special education compared to statistically similar White students, raising more concerns about the degree of inequality in this field as well as what factors might contribute to their lower representation (Morgan 2020). For one student population, AAPIs, the current discussion concerning the lack of demonstration of students of colour in special education is nothing new (Connor et al 2019). According to the definition used in this survey, AAPIs are Americans of Asian heritage who live in the country. National statistics from the last ten years show that AAPIs had half the possibility of accessing assistance as their White counterparts (Singh et al 2020). Only 2.3% of students receiving SE assistance identify as AAPIs, although making up around 5.1% of all students registered in schools. Approximately 11.9% of all students in California identify as AAPI, while only 6.7% of SE students (Cooc and Yang 2017). Even after taking into consideration the different backgrounds of AAPI students and other students, underrepresentation persists. It seems that previous empirical research on the underrepresentation of AAPIs in special education is reliable.

However, despite significant intergroup disparities in socioeconomic position, linguistic proficiency, and academic success, AAPIs have been considered as a single group in prior studies of SE disproportionality (Sullivan et al 2020). By

extension, it is expected that the underrepresentation of AAPIs is consistent across AAPI ethnic groupings. This fragile assumption has not been experimentally validated, but if it is incorrect, it might be detrimental to eliminating disparity and ensuring that AAPI students get timely treatment. It is important to examine special education patterns among AAPI ethnic groupings since they constitute the fastest-growing demographic in the nation. Doing so may help advance theories of disproportionality and provide light on current discussions regarding the underrepresentation of children of colour. We add to the body of knowledge on racial disparity and AAPIs in special education with this article. We examined changes in special education for 11 AAPI ethnic subgroups overall and by disability Using long-term data from 10 cohorts of kindergarteners from a school region. We also investigated whether AAPIs get special education at a different grade level, and we evaluated if representation gaps are linked to variances in student backgrounds.

## 2. Literature Review

Tohara (2021) provided the viewpoints of Malaysian educators on the topic of digital literacy skills as they relate to the student's education with special requirements. The cognitive skills, technology, and ethics that make up the digital literacy skills model serve as a foundation upon which to build an investigation of effective digital literacy pedagogy for students with special needs. Mustafa et al 2020 investigated the elements that contribute to the beginning of the workload for instructors participating in the SE Integration Program. Battal (2016) examined the origins, growth, and current state of special education in Saudi Arabia. The Ministry of Education is the primary service provider; hence the study's focus is only on its initiatives. Aldabas (2015) investigated Saudi Arabia's special education system and provide a historical outline of it. Since the introduction of SE in 1958, Saudi Arabia has made great progress in the service provision for students with impairments. Ruppar et al (2016) evaluated special education teachers' assessments of their readiness to put suggested strategies for students with severe impairments into practice.

Mason-Williams et al (2020) evaluated special education teachers' assessments of their readiness to put suggested strategies for students with severe impairments into practice. Davila (2015) built on three academic semesters' worth of ethnographic observations and provides incidents of disability microaggressions that are directed at Latina students who are enrolled in special learning programs. Morgan et al (2015) aimed to determine whether or not a disproportionate number of minority students registered in elementary and middle schools in the United States get special learning services. Kent and Giles (2016) were to assess the efficacy of a field component integrated into a revised teacher education program, with the ultimate result being the recommendation of undergraduate candidates for both K-6 common and SE certification. Odongo and Davidson (2016) focused on Kenyan educators and their thoughts on including students with special requirements in their normal courses. Teachers from 10 different primary schools in a single school district in Western Kenya were recruited for the research. Zhang et al (2018) looked at the emotional, cognitive, and conative perspectives of Chinese university educators on inclusive higher education. Teachers at Chinese universities seem to have a good attitude and analyse the rights of students with impairments to pursue higher education, according to the results of a recent survey.

### *2.1. Research Questions*

**Study Question 1:** What percentage of AAPIs across AAPI ethnic groupings are underrepresented in special education as compared to White students?

**Study Question 2:** How different is the scheduling of SE compared to White students for AAPI ethnic subgroups?

**Study Question 3:** What proportion of discrepancies in AAPI students' representation in SE compared to white students may be attributed to students and their family background factors?

## 3. Method

To study the experiences of AAPI students, researchers chose a suburban school area in California. This work is part of a wider district-researcher cooperation aimed at reducing racial inequities in the area's special education services, especially for AAPI students. More than 62,000 students were under the district's care during the school year of the year 2015-2016 Approximately 28.6 percent of all pupils identify with one of 11 AAPI ethnic groupings. Students from AAPI backgrounds make up 11.7% of California's student body, 5.6% of the nation's public-school enrolment, and 5.1% of the country's overall population. In the district, 11% of children get special education, which is comparable to the state's (12%) and the country's (13%) overall percentages. The district choice reflects trade-offs between the findings' generalizability and the model size and environment required to break down AAPI ethnic groupings. Since AAPIs are usually under-sampled by ethnicity in many studies across fields, the latter is a common methodological problem. Although the study's conclusions can only be applied to regions with comparably sizable and varied AAPI populations, the research's conclusions are nevertheless useful for districts where the AAPI population is expanding quickly. Additionally, the district's student characteristics and data sets provide a unique chance to investigate patterns among AAPI students in SE and develop hypotheses regarding disparity that might inspire further research in other districts.

### *3.1. Data Sample*

This study investigated academic information and demographic on every student in a suburban California school area from 2004 to 2013. The sample used for the analysis consisted of longitudinal data collected on ten groups of kindergarteners. While the kindergarten class of 2004 had nine years of data, the class of 2013 has just one full year of information. This is because not all cohorts begin at a similar time and give a similar number of years, as required by the staggered design. Only children who had just entered kindergarten were included to study the scheduling placement of special education throughout grade transitions. Cohort sizes have increased annually; the number of students has increased from 3,800 in 2004 to over 4,600 in the most recent year. The last sample includes 167,262 files representing 42,807 students from 41 communal institutions.

*3.2. Measurement*

The primary result was a continuous time-varying binary indicator, with the value 1 indicating that the pupil got special education and the value 0 indicating that they did not. The following disabilities each have their own time-varying special education indicator as a result of this study: difficulties with speech or language, particular learning disability, and Other Health concerns (hard of hearing, deaf, visually impaired, orthopedically impaired, or deaf-blindness). Indicator variables were developed for each of the eleven AAPI subgroups to analyse trends in special education for this population. All analyses in this research accounted for variations among students of different races, including those of African American, American Indian, Hispanic, and White backgrounds.

*3.3. Student and family covariates*

Placement in special education programs may be influenced by several variables. Gender, EL status, lunch assistance, parental education, and country of birth are all factors were all background factors that I accounted for. Additionally, to Parental guidance and free meals, the latter serves as a stand-in for acculturation circumstances that may affect children's school experiences.

*3.4. Student progress*

Student accomplishment is a crucial indicator of special education. Beginning in the second grade, students in California were obliged to take the consistent test and information in arithmetic and English Language Arts (ELA) every year from 2004 to 2013. On each exam, the raw scale values assortment from 150 to 600. The fact that pupils only start receiving scores for the achievement measures in 2nd grade, which would entail omitting data from kindergarten and 1st grade, is a problem. Additionally, studies utilizing the state results for students with more severe impairments who did not take the standard, unmodified test were omitted. Due to these factors, this research compared variations in model performance by race and ethnicity in children's ELA and math results from the second grade as a sensitivity analysis.

*3.5. Features of schools*

Several school characteristics may affect choices in special education, but they may be difficult to assess. Practices in special education could also vary by school. To account for reported and unnoticed school features, this study utilized school-fixed impacts in my models.

*3.6. Analysis Strategy*

This study utilized discrete-time survival analysis to analyse the Analysis of Longitudinal Data on the Association of AAPI with SE admission. The approach accounts for the filtering of students who do not encounter the occasion within the data duration when estimating the incidence of an event.

$$logit(g_{js}) = \sum_{l=0}^{l} \alpha_l C_{js}^{l} + \beta RACE_j + \gamma W_j + \delta_z + \varphi_t. \qquad (1)$$

This research indicates the risk of placing student $j$ in special education in grade $s$ as $g_{js}$or the likelihood that student $j$ will get SE in grade $s$ supposing the student has not yet been recognized. The vector $W_j$ in the discrete-time hazard model represents the logit of a hit as a function of grade, the student's race and ethnicity, and student variables. This research includes a set of kindergarten entering-year cohort fixed impacts in y to adjust for unobserved variations across cohorts. This research uses school-fixed impacts in $t$ to adjust for school variations that may have manipulated SE choices. This research integrated the fixed impacts of their first school since the majority of pupils who enrolled in special classes did so throughout the primary school years.

To answer Research Question 1, this research used an unconditional hazard model without variables to determine if AAPI subgroups are underrepresented in SE. The parameters in the vector, which depicts the likelihood ratios of AAPIs and other student groups being placed in special education in comparison to White students, are of interest. For study Question 2, the research examined the scheduling of SE for AAPI students by using scheduling duplicate parameters to illustrate the

likelihood that archetypal pupils from each AAPI grouping would be placed in special education over grades. This research incorporated interactions between the scheduling duplicate parameters and racial groupings to account for the possibility that the risk of special education may fluctuate over time. This research used a General Linear Hypothesis (GLH) test to see if the values collectively were tactically different from 0 given several communications. As the results of the GLH test were not tactically important, this study fixed models that only included the major impacts of the grade stage for parsimony. To answer study Question 3, this research examined differences across AAPI subgroups after adjusting for baseline traits. To do this, models including statistics about students and their families (Model 2), student accomplishment (Model 3), and school fixed impacts (Model 4) were compared to a baseline model without covariates (Model 1).

## 4. Results and discussion

In this research, we conduct an in-depth analysis of the thorough examination of special education for students of Asian American and Pacific Islander ancestry.

### *4.1. Study Question 1: Special Education Disparities*

The models for discrete-time survival analysis provide the regression findings shown in Table 1. Model 1 takes into consideration the longitudinal nature of the data and examines the question of whether AAPI students lack representation in special education compared to White students. There is a trend of underrepresentation of AAPI pupils compared to White students in the parameter evaluation connected with every AAPI grouping. The Odds Ratios (ORs) for special education placement were lower for all AAPI subgroups than for White students (p .001 for all), ranging from 0.42 for Cambodian and Korean students to 0.56 for Vietnamese and White students (controlling for grade level).

**Table 1** Multiple Imputations in separate scheduling endurance models for detecting Needs for SE Services.

| Variable | M1 | M2 | M3 | M4 |
|---|---|---|---|---|
| American Indian | 1.393* | 1.313* | 0.953 | 0.948 |
| Asian Indian | 0.422*** | 0..415**** | 0.418*** | 0.421*** |
| Latino | 0.893** | 0.839*** | 0.713*** | 0.739*** |
| African American | 1.281*** | 1.137** | 0.778*** | 0.817*** |
| Chinese | 0.456**** | 0.455*** | 0.588*** | 0.575*** |
| Cambodian | 0.706 | 0.642~ | 0.581* | 0.603~ |
| Hmong | 0.474*** | 0.437*** | 0.372*** | 0.393*** |
| Filipino | 0.515*** | 0.535*** | 0.540*** | 0.548*** |
| Korean | 1.052 | 1.162 | 1.151 | 1.119 |
| Pacific Islander | 0.544*** | 0.525*** | 0.508*** | 0.529*** |
| Laotian | 0.421*** | 0.389*** | 0.378*** | 0.388*** |
| Japanese | 0.513*** | 0.546** | 0.627~ | 0.646~ |
| Vietnamese | 0.562*** | 0.543*** | 0..508*** | 0.529*** |
| Other Asian | 0.527*** | 0.495*** | 0.491*** | 0.492*** |
| English learner | | 0.926~ | 0.710*** | 0.757*** |
| Female | | 0.437*** | 0.468** | 0.466*** |
| Free lunch | | 1.266*** | 0.938~ | 0.994 |
| ELA score | | | 0.994*** | 0.994*** |
| Parent education (≥BA) | | 0.944 | 1.110** | 1.075~ |
| U.S.-born | | 1.376** | 1.430*** | 1.379*** |
| Math Score | | | 0.997*** | 0.997*** |
| $H_0 : \beta_{Asland} = \cdots \beta_{OtherAsian}{}^{a}$ | ~ | * | *** | *** |
| School fixed impacts | | | | x |
| Cohort fixed impacts | | x | x | x |
| Observations | 167,795 | 167,795 | 167,797 | 167,665 |

A linear hypothesis test of equality revealed that there were in fact (although barely) distinguishable differences across AAPI subgroups (H0 AsInd Other Asian: = = 1.74, p =.063). Among AAPI groupings, Laotian students had the lowest likelihood of being placed in special education (OR = 0.42, p .001), while Vietnamese students had the highest. Model 1's findings corroborate both the widespread underrepresentation of AAPI groups and the need to disaggregate trends in special education enrolment for AAPI pupils. According to the US Branch of Education IDEA statistics, the odds ratios (ORs) demonstrating the disproportionate presence of African AAPI students are in line with expectations.

### *4.2. Study Question 2: Special Education Scheduling*

Figures 1 and 2 depict hazard and survival functions, respectively, that may be used to characterize the scheduling of special education. The general pattern in the hazard functions by Asian American and Pacific Islander subgroups and for the district indicates that children's likelihood of receiving special education assistance increases through kindergarten, then decreases precipitously through first grade before levelling out again in later years. In ninth grade, the risk likelihood significantly rises, which may be indicative of a problem with transitioning to higher school. However, the overall risk probabilities are modest, suggesting that only a small percentage of students need, and are likely to get special education. Except for Korean children, AAPI students' hazard possibilities of receiving special education assistance were lower than the predicted district average.

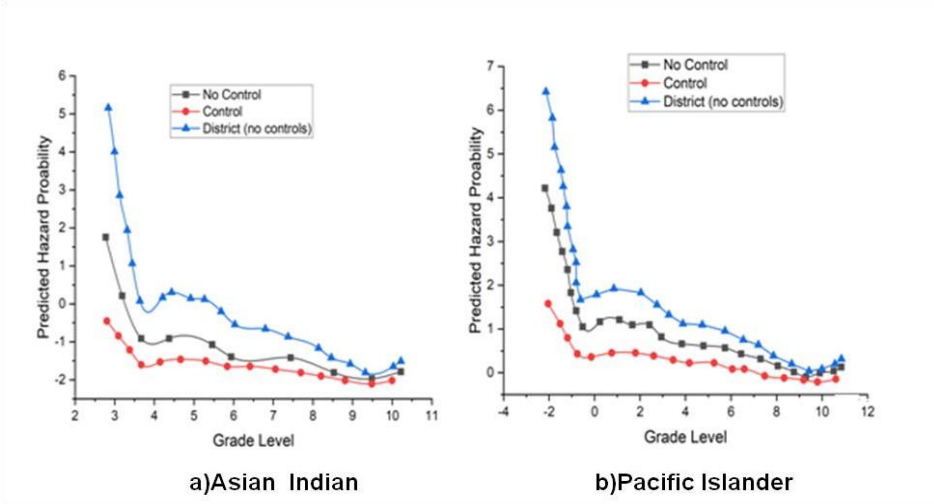


**Figure 1** hazards associated with Asian Indian and Pacific Islander special education services.

In comparison to the district as a whole, the hazard probabilities for four of the eleven AAPI subgroups were around half as low. When compared to the average hazard likelihood across grades, the scheduling of SE for Cambodian students was consistent. The likelihood that a pupil will make it through school without needing any kind of specialized instruction is shown in Figure 2 by the survival functions.

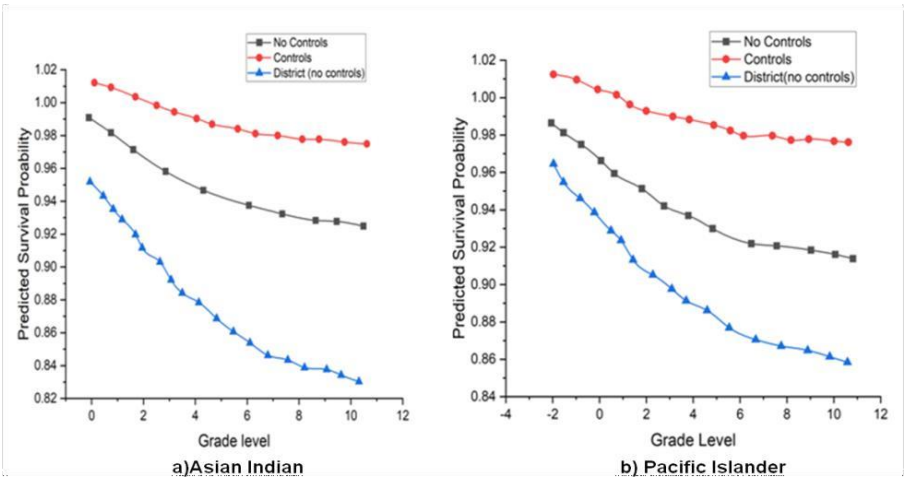


**Figure 2** Asian Indian and Pacific Islander students' cumulative probabilities of surviving beyond each grade without obtaining special education assistance are shown.

*4.3. Study Question 3: Taking Student Background Variables into Account*

This research used variables in Table 1 of the unconditional model to determine whether or not variations in student backgrounds may account for the underrepresentation and inequities in special education across AAPI subgroups. The primary socioeconomic factors and kindergarten cohort fixed effects are accounted for in Model 2. Nine of the eleven AAPI subgroups continue to be underrepresented compared to White pupils when it comes to special education, as shown by the parameter estimates linked with those groups. Model 3's control for student performance does not change this trend. Students of Hmong and Laotian descent who scored below the district average had a 63% reduced likelihood of being placed in special education than their White counterparts (p .001). To account for changes in schools that can affect special education choices across student groups, the last model includes school-fixed impacts. AAPI minorities continue to be

underrepresented in special education, with a 33%-62% lower likelihood of enrolment compared to White pupils. African-American and Latino students face similar representational challenges. With or without additional confounding factors, AAPIs were underrepresented across the board and in most subgroups.

For the most common types of disabilities, Table 2 provides models detecting the risk of special education services. Null findings may have been the consequence of inadequate statistical power owing to the reduced sample numbers by disability. Table 1 show that the complete model reveals parity with White students for half part of the AAPI categories, while the unconditional model shows a similar pattern to special education generally for students with speech or language impairment. Compared to White students, AAPIs are more likely to be underrepresented when it comes to having a particular learning impairment, as shown by their lower odds ratios. However, after accounting for demographic variables, Korean students still had a greater chance of accessing learning disability treatment than White students. Most AAPI groupings had rates of autism representation comparable to White children in both the unconditional and adjusted models. Similarly, no underrepresentation or inequality was seen for AAPI subgroups across all forms of health impairment.

**Table 2** Detecting SE services for individuals with disabilities using Discrete-Time survival models and OR with multiple imputation.

| Characteristics | Specific learning disability | Speech or language impairment | Autism | Other Health impairment |
|---|---|---|---|---|
| Latino | 0.792** | 0.835** | 0.707* | 0.556** |
| American Indian | 1.006 | 1.189 | 0.239* | 1.257 |
| African American | 0.884 | 0.730** | 0.676* | 0.682* |
| Asian Indian | 0.371*** | 0.475*** | 0.829 | 0.086* |
| Cambodian | 0.886 | 0.677 | 1.010 | - |
| Filipino | 0.425*** | 0.633** | 1.376~ | 0.133*** |
| Chinese | 0.362*** | 0.677** | 1.239 | 0.187* |
| Hispanic | 0.895* | 0.798** | 0.829 | 0.086* |
| Japanese | 0.558 | 0.807 | 0.339 | 0.546 |
| Korean | 2.462* | 1.163 | 1.471 | - |
| Hmong | 0.386*** | 0.545*** | 0.150** | 0.302~ |
| Laotian | 0.572 | 0.512~ | - | 0.463 |
| Vietnamese | 0.478*** | 0.848 | 1.453 | 0.167* |
| Pacific Islander | 0.662 | 0.554** | 0.849 | - |
| Other Asian | 0.390*** | 0.616** | 0.717 | 0.204* |
| English learner | 0.892 | 0.726*** | 0.552*** | 0.447*** |
| Female | 0.742*** | 0.456*** | 0.160*** | 0.496*** |
| Free lunch | 1.128 | 0.962 | 0.801~ | 0.597** |
| Parent education (≥BA) | 0.928 | 1.045 | 1.593*** | 1.113 |
| U.S.-born | 1.402~ | 1.351* | 0.962 | 0.556 |
| Any suspension | 0.978*** | 0.998*** | 0.997~ | 0.993*** |
| Math Score | 0.885 | 0.780** | 0.676* | 0.682* |
| ELA score | 0.993*** | 0.910*** | 0.994*** | 0.989*** |
| $H_0 : \beta_{Asland} = \cdots \beta_{OtherAsian}$ [a] | *** | *** | *** | *** |
| School fixed effects | X | X | x | x |
| Cohort fixed effects | X | X | x | x |
| Observations | 176,468 | 170,539 | 177,581 | 174,785 |

Recent research on the uneven enrolment of students in SE and it has highlighted trends of underrepresentation among certain students of colour in comparison to White students. Although there are substantial variances in the backgrounds of students, prior studies believed that the under representation of AAPIs was consistent among AAPI ethnic groupings. To enhance services for all AAPI students and contribute to discussions concerning disproportionality, it is necessary to examine SE trends by AAPI subgroups. The timeliness of services and variations in special education rates within a significant racial group in the United States are being examined for the first time in this research.

## 5. Conclusions

The under representation of AAPIs in SE, both overall and across the majority of AAPI ethnic groupings, as discovered in this research, is a warning sign that the system isn't fair to AAPIs. These patterns reflect how AAPI students are becoming marginalized in schools and how difficult it is for them to get treatment for a variety of problems, such as poor academic performance and peer harassment. It is hoped that by offering a fresh perspective on how AAPI students experience school to their disabilities and special education, this study's use of longitudinal analysis and disaggregated data will inspire other

approaches and theories to better comprehend the present education requirements of AAPIs. To further recognize how adaptation may affect attitudes and communications with the SE procedure, future research should use such assessments in conjunction with interviews with AAPI parents.

**Ethical considerations**

Not applicable.

**Declaration of interest**

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Analyzing the effects of a training programmed on the use of incidental teaching and targeted initiations by teachers with students with autism spectrum disorder

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**Abstract** An educational strategy known as incidental training motivates learners to seek out and participate in educational possibilities in their immediate surroundings. The aim of this research set out to find out how a 1-hour tailored course on incidental instruction, coupled with comprehensive feedback, would lead to improved execution of incidental teaching by educators and more focused beginnings by pupils who have ASD. Four teachers took an active role in the investigation. Through the one-hour customized instruction period, students were given an introduction to incidental teaching and given guidance on its guiding principles and tactics. Each teacher provided detailed comments on how they had implemented incidental teaching during sessions after the instruction. The results repeatedly showed that the instructional program boosted the correct use of incidental instruction among all teachers. After the first lesson, this enhancement was seen, and it persisted throughout the entire study. The teachers showed improved abilities in putting incidental teaching techniques into practice, having had an advantageous impact on how they interacted with learners who had ASD. The results repeatedly showed that the instructional program boosted the correct use of incidental instruction among all teachers. After the first lesson, this enhancement was seen, and it persisted throughout the entire study. The teachers showed improved abilities in putting incidental teaching techniques into practice, having had an advantageous impact on how they interacted with learners who had ASD.

**Keywords**: training, incidental teaching, ASD, language

## 1. Introduction

A neurodevelopmental illness known as an autism spectrum disorder (ASD) is characterized by difficulties with social interaction and communication as well as by constrained and repetitive activities and interests. In order to effectively teach and engage children with ASD, educators must have the information and skills necessary. They play a critical role in supporting their learning and growth. The application of accidental teaching and targeted initiations is one strategy that has demonstrated potential in fostering communication, sociability, and independent learning. The impacts of a training course on these techniques for instructors working with students with ASD are examined in this introduction (Hart Barnett 2018). The goal of the training program is to give educators knowledge and comprehension of the concepts and tactics related to incidental teaching and targeted introductions. Teachers can take advantage of student interests, foster communication, and social interaction, and create meaningful learning opportunities within the natural environment by implementing these approaches into their lesson plans. The curriculum also emphasizes the value of tailoring training to each Student's needs and helping ASD children apply their knowledge to practical circumstances (Immordino-Yang et al 2018).

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social interaction, and create meaningful learning opportunities within the natural environment by implementing these approaches into their lesson plans. The curriculum also emphasizes the value of tailoring training to each Student's needs and helping ASD children apply their knowledge to practical circumstances (Immordino-Yang et al 2018).

The training course also stresses the value of tailoring instruction for students with ASD Teachers gain the skills to recognize the distinctive strengths, interests, and areas for improvement in each Student and to adapt their teaching methods accordingly. With this tailored approach, teachers may support students specifically, scaffold their learning, and increase their motivation and engagement (Josilowski and Morris 2019). The training curriculum also places a strong emphasis on skill generalization. Teaching skills in naturalistic contexts and circumstances is the main focus of targeted initiations and incidental teaching. This method supports the independence and practical application of taught abilities outside of the controlled teaching environment, assisting children with ASD in making the transition from the classroom to the real world. Teachers acquire techniques to help students generalize their knowledge to different contexts and interactions, ensuring that the knowledge they gain has practical application (Algahtani 2017).

This study assessed the impact of a training program on how trainers implemented incidental teaching and how they specifically introduced individuals with autism spectrum disorder (ASD).

The remainder part of the paper is divided into subsequent parts. Part 3 contains method. Part 4 contains result and discussion. Part 5 discusses the conclusion.

## 2. Literature Review

Alai-Rosales et al (2017) demonstrated the possible advantages of incidental education for enhancing social skills in autistic children. Competence is a collection of actions that, when used in specific circumstances, produce specific results. The term "a social activity" in this context refers to a broad range of behaviour's, including various abilities like navigation, imitation, communication, distributing, and bargaining. Rittenhouse-Cea and Cho (2019) assessed the impact of a training program on how instructors implemented incidental learning and how they specifically introduced individuals with autism spectrum disorder (ASD). During a 1-hour special training session, four teachers were introduced to incidental teaching. Following training, detailed feedback was given for each accidental training session. McGee (2022) gave research-based proof of incidental teaching's (I.T.) effectiveness. A review of studies that used I.T. to apply to diverse demographics in various situations will be followed by a discussion of the origins of I.T. with young neurotypical youngsters. It will also look at research on preparation techniques. Neely et al (2019) looked at how individuals used incidental instruction after completing a telehealth pyramidal training program. Eight people in all collaborated with eight autistic kids. The initial step in training future interventionists was educating coaches on how to use incidental teaching. An online lesson and delayed video-based feedback delivered via videoconferencing made up the education packet.

Neely et al (2020) looked at the effectiveness of using international telehealth to train interventionists in incidental instruction. Written as well as spoken lessons, as well as videoconferencing with a delayed video response, made up the learning program. The participants in this study were two kids and five elders. Gunning et al (2019) summarized the research on the application of PMI in preschool settings for the teaching of skills to kids with ASD. 31 papers were chosen for inclusion after a thorough search of the literature from 1980 to 2018 was done. Wang and Krata (2017) would look at various educational theories for students with autism spectrum disorders. A review of methods and interventions based on empirical data showing their efficacy in the treatment of autism will be done, along with presentations of behavioural, developmental, and cognitive behavioural theories. The guiding principles of discrete trial training, early intensive behavioural intervention, incidental instruction, and key reaction treatments will all be part of the behavioural architecture. Gülveren et al (2017) intended to comprehend how special education teachers define play skills, explore their opinions regarding educating play skills for kids with ASD, and ascertain their experiences instructing play skills to kids with ASD A qualitative research method called the phenomenological design was employed in the study. Participants in the study included 14 special education teachers who were employed by a special need institution. A semi-structured interview was used to acquire the data. According to the study's findings, play skills were defined by special education instructors as entertaining and educational exercises. They also learned that teaching kids with ASD playing talents is important because they are so important.

AL-Gash any and Chandra (2022) aimed to investigate "Gluten and Casein Free Diet and Training Strategies of Developing Receptive Language Skills among Children with Autism Spectrum Disorders." The survey design was used in the study to accomplish its goal. Eighty literature evaluations have been gathered from a variety of sources, including reputable websites, books (both domestically and abroad), conference proceedings, and multidisciplinary magazines. Minjarez et al (2020) provided a summary of all the major naturalistic developmental behavioural interventions (NDBI) models, along with a concise review of the empirical evidence supporting each of them. Each incorporated NDBI model satisfies two requirements: an instruction manual or sufficient research was accessible to effectively describe the model, and the model itself or its basic components were regarded to be recognized treatments or practices based on evidence, unless they had additional strong proof.

## 3. Methodology

### *3.1. Participants*

In a suburb of the Midwest of Indonesia, the study was conducted in a private educational facility. Due to its focus on ABA, the centre teaches academics and languages using ABA in a one-to-one discrete trial approach, while smaller classes teach social and recreational skills. Table 1 shows the Instructor's data, and Table 2 shows the Student's data.

**Table 1** Instructor's data.

| Teacher Name | Age | Gender | Education | Training (towards RBT) | Employment Duration |
|---|---|---|---|---|---|
| Instructor 1 | 28 | Male | High School Diploma | 50 hr. | Five months |
| Instructor 2 | 35 | Male | Bachelor's Degree | 50 hr. | Over three years |
| Instructor 3 | 23 | Female | High School Diploma | - | Three months |
| Instructor 4 | 22 | Male | High School Diploma | 50 hr. | - |

**Table 2** Student data.

| Student | Age | Gender | Ethnicity | Duration of ABA. Services (Years) | Language Abilities | Strengths | Challenging Behaviors |
|---|---|---|---|---|---|---|---|
| Student 1 | 13 | Female | White | Over 7 | minimal understanding, basic sight word reading, and limited language skills | performing visuals while imitating a model | outbursts when denied access to desired products or in demand circumstances, violence, destruction of property, and self-harming conduct |
| Student 2 | 8 | Male | White | 4 | increasing speech length and variety by encouraging | simple requests for favored things seemed to interact positively with other people | - |
| Student 3 | 6 | Female | Asian | 3 (2 at this center) | Using one- to three-word utterances to mimic elementary conversations and independent requests | The reading ability for sight words (comprehension not tested) | Having trouble attending and being unmotivated |
| Student 4 | 14 | Male | Black | 8 | Mostly uses sign language, with little or no voice communication | Using signs to mimic brief, three- to four-word utterances is unreliable. | - |

### *3.2. Goal-directed Behaviour and Evaluation*

Target of students: Individual students' individual expressions served as the target language actions, which were chosen based on the Student's language skills and repertoires. Each time, the selected objective action was an improvement or augmentation of the currently available linguistic capabilities. If the pupil's introduction was a bubble, an example of elaboration maybe blows bubbles. The assignment for Student 1 was to ask for something while utilizing an entire phrase, including the term "please." For instance, he was urged to ask, "Can I have a truck, please?" Student 1 was able to begin sentences by himself, but he did so inconsistently and only used the word "please" when necessary. Student 2, on the other hand, was already making requests with full sentences and several carrier terms like "I want" and "can I have" He was free to unilaterally request his favourite items and supplies. He had trouble using wh-questions, nevertheless, to elicit more details. In order to solve this, Student 2's desired pattern of asking for something by saying "where" was chosen.

Instructor targets: The Individualized Transaction (I.T.) procedure's steps were all part of the goal behaviour chain for teachers. A number of steps made up this procedure: The process includes (a) preparing an atmosphere with favoured and focus on products, (b) anticipating the learner starting out, (c) preventing or denying access to the asked-for objects, (d) providing an appropriate prompt for clarification of the demand, (e) prompting if the specification was not met, (f) verifying the request, and (g) delivering encouragement specific to the start of the lesson, along with compliments. The trainer's behaviour was assessed using an I.T. assessment that outlines the seven stages required for an accurate I.T. installation. The

percentage of effectively implemented steps for every session was calculated by dividing the total number of correctly executed steps by the overall frequency of levels in the I.T. methodology. Individual instruction was given to each Instructor once baseline data was gathered from monitoring their proficiency in carrying out the steps. All the starting point, intervention, and generalization sessions were recorded on video, which the first author afterward examined and evaluated. The subsequent author then randomly confirmed the first author's scoring correctness.

*3.3. Interobserver Agreement (I.O.A.)*

Interobserver agreement (I.O.A.) was assessed individually for video-recorded sessions by the first researcher and the research assistant, a White female with two years of experience teaching ABA. And seven years of supervisory and consulting experience for ABA Programs. The observers assessed staff and student behaviour individually after each session, and they later checked their rating sheets for consistency. I.O.A.s was evaluated for 27 sessions altogether, or 77% of each session for the Student and the Instructor, which satisfies the need of at least 20% for a single-case intervention research design. In order to determine the I.O.A., the total number of agreements was divided by the total number of agreements + disagreements, multiplied by 100. This produced a mean I.O.A. of 94% for student beginnings and 95% for implementation by educators among sessions.

*3.4. Procedure Integrity*

Using the checklist they created, the writers evaluated the procedure's faithfulness. The checklist measured how closely the instructions for the training regimen that explained the I.T. operations and gave feedback were being followed. There were five to twelve sessions per participant, based on how long they were in the phase of the intervention, and all instructors were asked to complete a checklist after each session where feedback was offered. The faithfulness was a mean of 100% for the three of them who completed the list of tasks 28 times.

*3.5. Social Acceptance*

The Social Validity Rating Scale (SVRS), which was modified from TARF-R, was used to evaluate the social validity of the I.T. technique. The scale has 15 items that assessed factors like acceptability, willingness to utilize the procedure, drawbacks, efficacy, feasibility, suitableness, and execution difficulty. On a Likert-style scale of 1 to 5, trainers gave their opinions of the instructional method. Along with the likelihood that mastering the approach would improve instructors' efficacy, there were questions about the possible effects on all students' linguistic growth. The average rating for the instructors after gathering information was 4 (interquartile range: 3-5), demonstrating favourable relevance in the community.

*3.6. Design and Techniques*

A single act was measured over numerous student participants using a multiple baseline methodology, and another behaviour chain was measured across multiple instructors using a separate baseline design. The experimental conditions included baseline, generalization, and I.T. technique training as the intervention. For the student participants, the order of the interventions was randomized. For a duration of eight weeks (with an average of twenty-four hours per Instructor), I.T. courses were provided in a one-to-one environment, between two and three days a week, for a total of three classes each. Between each instructional session, pupils were allowed time to engage in additional activities. The techniques indicated were followed by the instructors as they conducted rapid paired stimulus preference ratings before and during each session. In this evaluation, things were shown in pairs, the Student was given the opportunity to choose one, and the unselected item was then taken away. Before the following presentation, the Student received the chosen object for 5 seconds. Teachers were required to conduct an I.T. session before each class before gathering their materials and bringing the target learner to the classroom.

Baseline: The first writer conducted five-minute meetings with observers to obtain data on learner initiations, language elaborations, & the teacher's usage of I.T. processes. It was succinctly described by the teachers as a realistic teaching method that makes use of motivation for preferences to support language. A copy of the I.T. checklist was also given to them. The teachers received no additional guidance on how to apply instructional or I.T. procedures, directions, or comments. The teachers received no extra guidance on how to apply instructional or I.T. processes, directions, or feedback. The Student's language objectives were disclosed to the instructors, and they were instructed to lead an I.T. session. Depending on which teacher behaviours were being targeted for intervention, there were varied amounts of possibilities for student initiation during baseline. They had complete access to all course materials at all times. Both the play area and the Student's classroom were used for all inspections.

IT education: Throughout daily breaks, training courses for instructors were held in their own classrooms. Every Instructor went through an hour-long personal course which included reading and debating an analysis of the I.T. actions as well as responding to and answering questions about the I.T. process, such as what to do if the Student began with the entire meant more information and how to lead an explanation. Putting processes into effect with the trainer in role-play scenarios,

(c) watching records of I.T. processes being explained in-class activities with learners, (d) gaining feedback on the use of I.T. via role-play, and (e) putting procedures into practice with the trainer. The instructional materials were presented visually throughout the instruction session via PowerPoint presentations. Through role-playing activities, the instructors also received detailed corrective feedback for errors made.

IT seminars: According to the outcomes of a preference assessment, instructors decided which three to five items every pupil should have as their top choices. These things were thoughtfully positioned between less desired items on the floor or toy shelves. The teacher then stepped inside the classroom and took a position two feet from the instructional materials. The teacher waited for the pupil to approach a particular object. In response to the learner initiation, the teacher delayed the item and asked the pupil for more details. The hint for an explanation might be "sections" or "I want blocks," for instance, if the learner reached for a container of building blocks. When a pupil couldn't speak "blocks," the teacher offered a simpler approximation like "buh" or a hand signal. Once the kid had finished elaborating, the teacher would say something like, "Blocks, that's correct," or "Yes, you're able to have the block." to recognize their response. The product was then given out, and verbal praise was given. The instructional trial (I.T.)'s first episode was concluded with this. The teacher altered the desired objects, the materials, or the learner's proximity to them to facilitate further I.T. trials. A minimum of 10 possibilities for I.T. interaction were provided during each session. Each new I.T. connection was scored for the remaining five minutes of the sessions. The learning spaces of the pupil volunteers hosted all of the I.T. sessions.

Feedback: After watching each recorded session, written feedback was given that included compliments, suggestions, corrections, and information from the I.T. checklist. A few examples of praise were "You are doing a fantastic job of finishing Steps 1-3 on the I.T. assessment correctly and consistently!" and "You're doing an awesome job!" When the learner made a request, the corrective feedback concentrated on delivering behaviour-specific praise, highlighting the preferred language usage, such as expressing "Sure that you are able to play with the harmonica" as opposed to general praise. According to each Student's needs, suggestions were made for language-building activities, like playing taking turn’s sports or purchasing some food from the gym's food machine. In order to track progress, the discussion sessions comprised comparing recent and historical data. Instructors were urged to examine their videotaped I.T. courses as they read the feedback to ensure comprehension and clarity. Instructors were given more compliments when they showed resistance to receiving criticism. Meeting the requirement of a minimum of 80% accurate implementation over two successive observations was necessary to advance to the generalization stage.

Generalization: The goal of instruction and pupil targets in the generalization period were identical as in the I.T. stage, but fresh resources were used in a variety of contexts. Classrooms, the dining area, the outdoor playing field, the leisure room, and the YMCA's (Young Men's Christian Association) training facility, which was near the school and was frequently utilized by the pupils, made up the normal surroundings. At this point, there was no formal training given to the trainers; rather, feedback was given based on how well they performed on the I.T. checklist. For them to successfully demonstrate generalizing, they have to keep trying to meet the demand for 80 percent precise performance.

## 4. Results and Discussion

The effects of instruction on the utilization and Generalization of I.T. by teachers of students having ASD, as well as its effect on language acquisition results for students, were examined. Data indicated that the education course had effectively raised the standards of performance for all four teachers. Figure 1 displays the proportion of all teachers who completed I.T. steps successfully throughout the baseline, intervention, and generalization periods. The findings demonstrate that the mean proportion of correct I.T. actions across each of the four teachers rose consistently when training and continual feedback were implemented. At the beginning of the phase, the average instructor percentage of accurate deployment was 37%. In the intervention phase, the mean improved to 77%, and in the generalization phase, it increased to 90%, indicating that the skills remained at greater levels than those displayed at baseline. The shift in teacher behaviour that corresponded with the application of the variable that was independently served as evidence of the controlled experiment.

### *4.1. Increases in I.T. Instruction and Instructor Progress*

The research's teachers demonstrated varied degrees of development and performance while putting the Individual Training (I.T.) approach into practice. Instructor 1 made the greatest rapid and sustained progress. With an average of 47% at the beginning and 85% during the intervention phase, his corrective measures climbed steadily. Instructor 1's performance held up well in the generalization step, scoring a mean of 97%. Since Instructor 2's forceful verbal pressuring of the Student caused a decline in achievement during a single lesson, she first battled with the effective I.T. application. Her accurate steps, nevertheless, improved and achieved an average of 75% throughout the therapy period. Sadly, because her time at the institute was drawing to an end, Instructor 2 was compelled to stop conducting research after the first generalization incident.

When Instructor 3, a fresh staff member, first tried to lead I.T. meetings, she had trouble doing so and ran into problems with the teaching style. Instructor 3's results did, however, considerably increase once she received detailed

comments and practiced I.T. procedures for two days. During baseline, treatment, and generalization, she consistently followed the right I.T. procedures at least 30% of the time and 82% of the time overall. Since Instructor 4 also experienced confusion as a result of conflicting training at the centre, her results during the intervention period varied somewhat. Her acting was nevertheless enhanced by practice and specific suggestions, and throughout therapy, the proportion of precise steps rose to 66%. In general, the instruction procedure's execution helped all four instructors' instructors perform better. The lack of behavioural changes previous to the intervention and the rapid onset of changes during the intervention phase suggested that the training given by a single instructor had no impact on the effectiveness of other teachers.

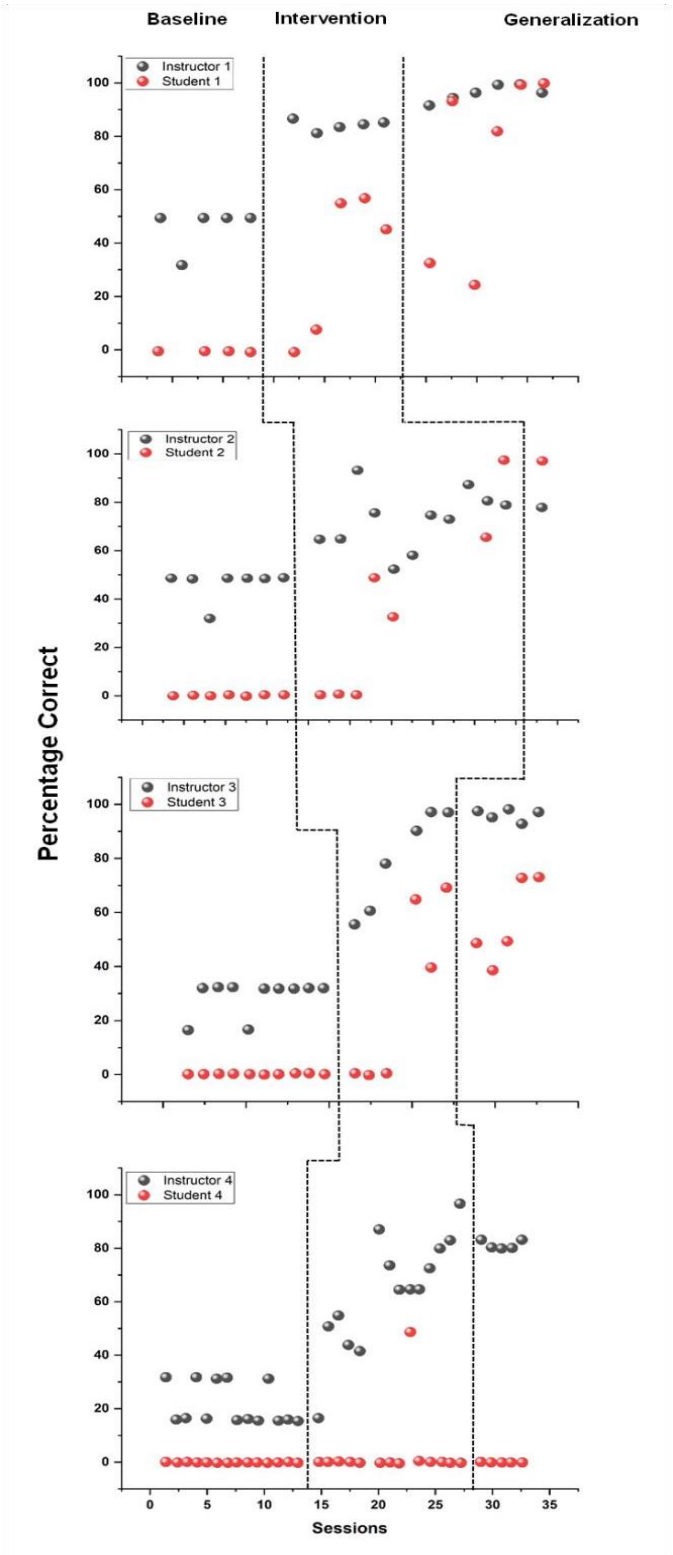


**Figure 1** Percentages of effective student beginnings and incidental instruction execution for every single one of the teachers.

Given that the same results were obtained among instructors, this raises the possibility that the training program contributed to the enhancement of educators' competence. Evidence that generalization had taken place came from the educators' capacity to effectively deploy I.T. in a variety of contexts. The percentage of all non-overlapping data points (PAND) was employed as an indicator of effect size to assess how well I.T. teaching was working. When comparing baseline and I.T. training, every Instructor had 100% PAND scores, showing that the therapy was exceptionally efficient. In conclusion, Instructor 1 demonstrated the most constant enhancement, while the other teachers also made strides in putting the I.T. process into practice. Due to Instructor 2's withdrawal from the research, her progress was halted. Instructor 3 and Instructor 4 initially had difficulties but overcame them through practice and focused criticism. The high PAND wins, which showed the therapy's efficacy among all teachers, made it clear that I.T. education was successful.

### *4.2. Student Development and Improved Instructor Achievement*

According to the research, the adoption of the initial approach to instruction for instructors increased the language proficiency of the targeted students in comparison to starting levels. The performance of pupils significantly improved as teachers got more adept at utilizing I.T. in the classroom, which was indicated by a rise in the use of focused language abilities. The typical percentage of language beginnings among students throughout the first period was zero.

However, following BST (behavioural skills training) for educators, the mean increased to 26%, with a range of 0% to 71%. The standard deviation, with a range of 0% to 100%, further rose to 58% in the generalizations stage. According to these results, pupils started to acquire the language they wanted abilities as instructor performances grew more trustworthy. The percentage of the initial answers that were appropriate for every pupil at baseline, during I.T. sessions, and during generalization is shown in Figure 1. For instance, Student 1 used 0% of the goal behaviour at baseline. However, it increased to 33% over the course of the therapy, ranging from 0% to 57%. Student 1 received a score of 72% on the generalization phase, with scores that ranged from 25% to 100%. Student 1 demonstrated his proficiency in the focused reaction by earning 100% on the final two generalization sessions. The goal behaviour was used individually by Student 2 0% of the time at the starting point, but after therapy, it climbed to a mean of 36%, ranging from 0% to 100%. Student 2 consistently used the right initiations 100% of the time throughout the only session devoted to generalization.

Throughout the treatment, Student 3's proper execution of the targets "I want" and "can have" increased from 0% at the beginning to 30%, with a range of 0% to 71%. The section doesn't include particular details about Instructor 3's development, and the information for the previous year’s wasn't graphed. Student 4 had difficulty reaching the goal of using a one- to three-word appeal combining the use of sign language with vocalization initiations, starting at 0% during the initial stage. In the first session of the treatment stage, there was some improvement, and 50% of the efforts were effective. The percentage of accurate initiations, however, dropped to 0% during the process of the generalization phase. The progress of Instructor 4 is disappointingly not mentioned in the text. To evaluate the impact of information technology instruction on pupil language results, the PAND was used to identify the scales of impact.

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## 5. Conclusions

Implementing I.T. after BST workshops and receiving thorough input significantly increased the teachers' capacity to integrate I.T. into their lessons. As a result, there was an increase in ASD student beginnings from the baseline to intervention periods. This outcome underlines the significance of providing teachers with timely and detailed feedback while they are undergoing I.T. training and deployment. Our findings imply that instruction, along with data and feedback display, can effectively encourage instructors to use I.T. correctly. In spite of the fact that pupil information is frequently not recorded, studies point to a relationship between BST in teachers and improved student language outcomes. The results of our research corresponded with its findings in the fact that after getting technical instruction from pertinent teachers, all student participants showed increases in verbal starts toward the goals of the investigation. Although gains varied amongst individuals, all students saw an increase in the proportion of right initiations, and two students' impression value statistics were judged to be extremely and fairly effective.

### *5.1. Implications for Practice*

The primary goal of instruction is to improve the efficacy of teachers in delivering studying, self-help efforts, and social materials in order to achieve the best outcomes for students. It's essential information for educators of ASD children. Because these individuals often grow more slowly and find it harder to maintain and generalize their skills. These instructors, who are frequently Para professionals or beginning behaviour therapists, frequently lack teaching experience, behavioural instruction, or specialized awareness of the requirements of people with impairments. According to research, workshop-style instruction, which is often given to these teachers through continuing education, is inefficient at changing instructors' behaviour over the long term. These educators can be educated on particular instructional protocols fairly quickly and effectively, according to the findings of this study and others, provided they have the chance to learn and get comments in a natural setting.

### *5.2. Limitations*

As the research went on, it became clear that the evaluation methods used could not accurately gauge Student 4's linguistic improvement. But he didn't independently show that he could sign and vocalize at the same time. He only showed that he could do one or the other. The measurement instrument wasn't altered because of time and other limitations. Because of this, Student 4 didn't make a lot of progress with the chosen objective, while improvements occurred with a closer approximation of the goal.

### *5.3. Future Research*

Further studies could look at the types of guidance that might be required to further develop educational techniques for incidental instructing as well as enhance the capacity to respond appropriately to various students in various circumstances in order for educators to effectively demonstrate generalization capacities via a variety of stimuli. The development of an evaluation procedure that is quicker and simpler for managers to use would also be useful.

## Ethical considerations

Not applicable.

## Declaration of interest

The authors declare no conflicts of interest.

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Getting closer to the achievement gap in urban education, promoting first-year reading success

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**Abstract** The goal of this research was to evaluate the efficacy of Reading RACES (RR), a computer software that offers a repeated reading intervention with culturally relevant texts. This research definitely looked at how RR affected first-grade students in an urban setting's oral reading fluency (ORF) and comprehension gains, as well as whether such improvements would transfer to unfamiliar, generic texts. Five African American first-graders at risk of failing to master reading skills were chosen to take part in this research. The usage of RR and student increases in ORF and understanding were shown to be functionally related, according to the results. The ORF and understanding of rehearsed passages improved moderately too significantly for all research participants. The findings also demonstrated that even a month after the intervention, reading abilities persisted and were generalized to fresh texts. These results increase the body of prior evidence that supports RR.

**Keywords**: culturally relevant, reading RACES, ORF, DORF, AIMSweb

## 1. Introduction

Closing the achievement gap is important for fostering social mobility and educational fairness because it guarantees that all students, whatever their circumstances, have equal opportunity to realize their potential and achieve academic success. The achievement gap is the term used to describe ongoing differences in learning performance and educational accomplishments between different student populations. The inequalities in academic performance between students from low-income families or disadvantaged groups and their counterparts from more privileged backgrounds are often the subject of the phrase. The achievement gap can appear in a variety of ways, including disparities in academic success, college enrolment, graduation rates, and standardized test scores (Broer et al 2019).

Urban education is the branch of schooling that concentrates on the special difficulties and possibilities that urban or inner-city settings bring. It takes into account the particular requirements and conditions that apply to students, teachers, and schools in metropolitan areas. The study of urban educational institutions as well as the creation and application of plans to enhance educational results in urban settings are all included in the field of urban education (Barber 2021). Urban education works to reduce the achievement gap that exists among urban learners and those living in regional or rural regions by offering fair educational opportunities. It underlines how important it has become to modify instructional strategies and assistance programs to address the unique demands of urban children. A multidisciplinary strategy for urban education takes into account elements including curriculum creation, teacher preparation and support, community involvement, school leadership, social services, and educational policy. To promote a safe and caring learning environment for children, coordination between teachers, administrators, lawmakers, community groups, and families is often necessary (Bryan et al 2020). Urban education initiatives can concentrate on a variety of things, such as enhancing academic performance, decreasing dropout rates, increasing college and career readiness, fostering cultural responsiveness, encouraging social and emotional growth, addressing systemic inequities, and developing safe and welcoming school environments. Urban education attempts to guarantee that all children in urban areas, irrespective of their socioeconomic standing or conditions, have access to high-quality education and opportunities that will set up them for success in school, jobs, and life (Peacock et al 2021). Promoting first-year reading success is the practice of supporting and advancing pupils' comprehension skills and accomplishments throughout their initial period of higher learning or schooling. This emphasis on first-year proficiency in reading acknowledges the vital contribution reading makes to a child's overall academic growth and potential for achievement. Promoting first-year reading achievement primarily aims to make sure that children acquire solid reading core abilities such as recognition of phonics, fluency, vocabulary, and comprehension. Teachers and parents may help young students become competent readers and cultivate a lifetime affection for reading by offering tailored teaching and interventions. The achievement of first-year readers lays a solid basis for future academic success (Clarke and Burt 2019) The

proactive procedures and tactics used to make sure that first-graders in an urban education environment achieve good reading outcomes and avoid challenges with reading acquisition are known as avoiding urban first graders from falling behind in reading. Early detection of students at risk of reading failure and the implementation of focused interventions to meet their requirements are required (Lekwa et al 2019).

The persistent differences in performance in school and educational achievements between various student groups, particularly along racial and socioeconomic lines, are referred to as the achievement gap. In urban schooling, where discrepancies often are more severe owing to numerous social and economic variables, closing this gap is essential. A term that stresses the objective of reducing this gap and fostering fair educational opportunities for all students in urban settings is getting closer to the achievement gap in urban education. It suggests a concentrated effort to lessen the gaps between less advantaged students and their more fortunate peers by improving the educational experiences and results for underprivileged students (Plucker and Peters 2020). Providing early learning programs, implementing evidence-based instruction in reading, offering more assistance for readers who struggle, encouraging enthusiasm for reading through interesting and culturally relevant materials, encouraging parental involvement in literacy activities, and offering professional development for teachers to improve their instructional methods are some actions that can be taken to promote first-year reading success (Lewis 2019). To examine the consequences of combining CR pedagogy with RRI based on studies on the reading fluency and comprehension of at risk first graders in an urban context, the present study used a hybrid approach.

## 2. Literature Review

Von der Embse et al (2019) looked at the processes and procedures required to provide urban school-based mental health services at Tier I and Tier II. This decision-making framework was created via an iterative process including input from school-based partners, regular and scheduled reviews of program efficacy, and the gathering of data to inform important decisional cut points. Hinnant-Crawford (2023) investigated the connection between teacher-reported classroom goal orientation and U.S. federal education regulations. In a sequential explanatory approach, survey data from around 260 instructors and seven teacher interviews were examined together. The impact of accountability rules on student results and, to a lesser degree, education, has been studied by academics. Little empirical research has looked at the connection between policymaking and pedagogy outside of test preparation and curricular specialization. Brown et al (2019) ignored the numerous methods hazards for educational failure are generated within routine educational processes and instead interprets risks expressed as statistical chances and mostly concentrated on static and individual risk variables. The idea of hazards is often used in dropout investigations as an approach for comprehending the ongoing issue of high school dropouts among learners of color in urban schools. Tanase (2022) provided 22 secondary math and science teachers monitoring. The objective was to evaluate the cultural responsiveness of some of the tactics utilized in urban schools. In all metropolitan environments, demographic statistics indicate that the student population is becoming more diverse. On the opposing side, there is still a disparity between the student and the teaching force in the US, with the majority of instructors being female, middle class, monolingual, and of European heritage. Lee et al (2021) determined 327 urban middle school children were assessed for their educational self-handicapping behavior, success-oriented mind-sets, and math and reading performance. To determine if attainment objectives were responsible for the relationship between past performance and self-handicapping behavior and how the connections were affected by the presence of disadvantaged minority students, mediation-based regression analyses were carried out. Hines et al (2021) investigated the way pre-service teachers saw their readiness to instruct utilizing CRP techniques in the classroom. There has to be a paradigm shift to bridge the accomplishment gap. An attitude shift is necessary to address the accomplishment gap. To implement this transformation and link classroom learning goals with students' daily lives, CRP tactics must be used. This will lessen achievement gaps in schools. Butler et al (2021) inquired to learn more about the pre-and post-college experiences of Black men who were successfully admitted to a postsecondary school. Males of color face several obstacles to attending college and are commonly disadvantaged in postsecondary educational institutions. McCallops et al (2019) evaluated how preservice teachers' attitudes about justice and how they see working in urban schools relate to each other. Using a critical interpretative case study approach, we examine several journal entries from a varied group of aspiring teachers to see whether their perceptions of urban schools and children were affected by their involvement in service-learning activities.

Sims and Ferrare (2021) addressed the significance of these results and provide suggestions for further investigation into treatments for social-emotional learning that are culturally appropriate in urban schools throughout the world. Urban schools that compile and analyze 51 research findings on student results, culturally sensitive techniques employed in each intervention, and strategies implemented. Hoffman and Martin (2020) received a step in examining this variance by looking at how first-generation college (FGC) freshman from rural and urban areas utilize their social networks differently to assist them in making college major and career decisions. FGC students are defined as having parents with comparable levels of education, and they often get assistance on university campuses as if they are a homogeneous group. The varied histories of FGC students, however, may call for various kinds of assistance. Tichavakunda and Galan (2020) provided a preliminary analysis of a middle school language arts and literacy program used by an urban school district. They examine the effects of the district's switch to non-skill-based Reading and Writing Workshop Models curriculum by speaking with a limited number

of 4 educators along with a literacy coach, collecting preliminary data, and watching students in literacy schools. Henry (2019) examined a cohort of 33 recently graduated students from the same urban, public high school to better understand this crucial period. First-generation students have particular difficulties throughout the summer before college because they often lack supervision in performing chores connected to the college.

## 3. Methodology

This section discusses ensuring educational fairness and enhancing student results, including closing the achievement gap in urban education and encouraging first-year reading performance.

### *3.1. Setting*

Pre-K across fifth graders attended the urban primary school where this research was conducted. The institution of learning was located in a big city in the Midwest, and the majority of its kids hailed from low-income homes. 92% of the students in this research were Black, 5% were White, 2% were Multiracial, and 1% were Hispanic. In two distinct first-grade classes where reading teaching concentrated on entirety categories actions with continuation worksheets and individual tasks in each classroom, participants for this research were chosen from the student body. The investigation was conducted in the school library's rear section, which included a computer workstation with sufficient outlets for the laptops needed for this research assignment.

### *3.2. Participants*

This research included five first-graders who had reading difficulties. Utilizing reading evaluations from Fountas and Pinnell, the first-grade instructors selected for study participants the student who were not doing well in reading at the start of the year. The Dynamic Indicators of Basic Early Literacy Skills Next (DIBELS Next) edition subtests DIBELS Oral Reading Fluency (DORF) and Nonsense Word Fluency (NWF) were used by the investigators to expand on these youngsters' decoding and oral comprehension abilities. Students have to fulfill the following requirements in addition to instructor recommendations, to indicate poor reading fluency in comparison to their peers, students must read at least 18 Correct Letter Sounds (CLS) on the NWF subtest and obtain the smallest DIBELS ORF (DORF) values on screening. The single participant, Noah, who was not suggested by the teacher, was additionally one of the lowest scorers and fulfilled the decode requirements. Since there existed no baseline for preschoolers at the start of the year, investigators were unable to adopt a particular cut-off for the DORF. Table 1 for an overview of application information and starting grades.

**Table 1** Information about participants and screening tests.

| | | | DIBES | |
|---|---|---|---|---|
| Name | Gender | Age | Median ORF | NWF |
| Tristen | Male | 6-10 | 11 | 47 |
| Noah | Male | 6-2 | 14 | 24 |
| Mia | Female | 7–0 | 9 | 26 |
| Jerry | Male | 6-6 | 9 | 40 |
| Jack | Male | 6-9 | 5 | 23 |

The data shows that the majority of SHG members are experiencing social groups for the initial period. The majority of them were presented by current members. This demonstrates that the informal trust and solidarity amongst current members support the formal building of social assets of SHG formation. A large number of monthly meetings and increased opportunities for members to rotate into important roles like chairman, secretary, or treasury of SHG have aided in maintaining the social asset.

### *3.3. Materials*

#### *3.3.1. Computer equipment*

The RR software was provided through four Dell laptops. To operate the reading application, among these laptops was utilized serving and coupled with a Linksys Wireless Broadband Router. The RR system as well as the delivery of CR and Nonculturally Relevant (NCR) sections were carried out on the other computers. Each laptop came with a wireless mouse, a Logitech headphone featuring a microphone so that learners could hear the course material while collecting their readings, and an audio recorder.

#### *3.3.2. CR maze passages*

Deleting each seventh word from the passage, researchers produced maze comprehension evaluations that mirrored the CR passages; students chose the correct word from a list of three options to fill in the blanks. When the student clicked

on the appropriate term, it was clear that they had understood. Once the maze was complete, RR determined the right solutions and created a grid to show the beginners their test-taking progress. A star was added to the graph of every student who completed the maze evaluation with a perfect score.

*3.3.3. RR software*

Students were given CR and AIMSweb Passages (AP) using this program utilizing the Repeated Reading Instruction (RRI) sequence.

*3.3.4. CR passages*

To gather background material for their tales, previous researchers on this investigation visited instructors, parents, and children to construct 25 first-grade CR passages. The sections with an assessment range of 1.4 to 2.6 were compared using the Spache Readability Index and an approach to statistics.

*3.3.5. Generalization passages (GP)*

GP were chosen by investigators from the AIMSweb dataset. Since the passages in AIMSweb were generalized and didn't expressly target being made culturally sensitive to the community of this research, they were noted that NCR portions in this investigation. The Spache readability method was used to choose passages from this dataset based on the level of education challenge, which ranges from 01.4 to 02.6.

*3.3.6. Rewards*

Following the conclusion of the day's intervention session, students choose a sticker.

*3.4. Materials*

Researchers used an approach with multiple baselines among individuals to assess how the RR intervention changed students' ORF and comprehension of CR and AP. To assess if students individually observed the computer order, investigators also gathered operational integrity.

*3.4.1. Independent variable*

The RR intervention, which included CR and conceptualization passages as well as the RRI supplied via computer software, served as the independent factor in the study. In 11–15 weeks, participants attended between three and four sessions each week, each of which lasted between 25 and 40 minutes. After reading a narrative, participants got comments from the RR software and encouraging remarks from the investigators. Using 25 CR and 17 AIMSweb tales, the RR computer software performed an ongoing reading treatment. Students heard an individual read a chosen text before having the chance of practicing reading it themselves thanks to RR. Learners may click on unfamiliar phrases while rehearsing the tales, and the system would then read the passage to them. A system program afforded students any missing cold reading preparation sentences. This part included the processor simulating reading a particular word before reading it in the context of the phrase. Students achieved their objective, the maze exam was administered by the computer, and a graph of their results was shown. After finishing each labyrinth, students examined their graphs; however, no particular data were gathered to determine how seeing the graphs affected the students' reading abilities.

*3.4.2. Praise and corrective feedback*

The researchers commended the student for their concentration, diligence, and accomplishments after the sessions. The students got corrected feedback on every single reading fault made throughout the instruction portions of the intervention. During the evaluation phases, there was no feedback provided.

*3.4.3. Praise and corrective feedback*

The initial factor that depended proved students' CWPM throughout the CR oral passages on RR cold read. Phrases scored against the student's total if they were read properly within three seconds or if the learner committed a first fault before individually fixing it. If a student pronounced an item incorrectly or did not say it within three seconds, the word was considered wrong. Following the 1-min time, the investigators entered each pupil's last words read and any mistakes and the computer then estimated the student's CWPM. After their first read, students participated in the reviewing words section of the intervention, where they practiced the phrases, they overlooked to get correction feedback. The CR maze assessment's accurate replies served as the second dependent variable. If the word chosen was an original phrase from the narrative, the response was considered right. Students could observe a line graph as a result of their proper responses. For this evaluation, zero corrections were made. In the GP, the students' CWPM served as the third dependent variable. After achieving their aim

while reading the CR chapters, students read GP. Students were supplied a section with a generalization if they performed successfully in reading three consecutive CR tales on their first try. Students were not given a GP until after they had successfully read three CR tales if they were required to read the tale a second time. The student's performance on the generalization mazes served as the fourth dependent factor. The mazes performed in the same way as the CR mazes.

The student's level of development based on their DIBELS Next standard tests administered at the start of the academic and end of the year served as the fifth dependent factor. The typical every-week increase for students' ORF may be computed by considering their starting CWPM, using “Hasbrouck and Tindal's” ORF information. The typical weekly phrase increase for individuals was multiplied based on how many weeks they took component in the intervention, and the result was added to their original midpoint DIBELS ORF to get their predicted ROI. For children in preschool into the third grade, DIBELS Next assesses fundamental early reading abilities. Investigators adhered to the administrative guidelines established by the DIBELS Next designers. Based on Kaminski, Dewey, Powell-Smith, and Good, the first-grade NWF's alternate-form dependability was 0.85 for a just one test and 0.94 for the 3-test form. Availability on the first-grade DORF was 0.91 and 0.96 for the solo and three-test versions, respectively.

*3.5. Processes*

*3.5.1. Baseline*

Students examined six stories, 3 from CR and 3 from AIMSweb, in an arbitrary sequence. The students started by pressing the “timed reading button” and reading a passage for one minute. For this single read, investigators gathered ORF information related to various cold read judgments. Students next completed the 3-minute labyrinth test that corresponded with the paragraph they had just read. Children read one piece per day, and the investigators used analysis of data to identify which children should be put in the top tier following at least six days of baseline reading. The first two people to undergo intervention had the least stable ratings.

*3.5.2. Training students for RR*

Participants got instructions regarding how to use the RR software before beginning the intervention. To guarantee procedural integrity for all of the participants, a training screenplay was developed. Following the plan, the investigators demonstrated each step to the participants. The lesson from the CR tale (Grandma's House) which was used exclusively for instruction and was never a component of the intervention, was utilized to guide individuals over the precise order of the program. Before starting the intervention, contestants had to complete every item on the instruction worksheet accurately.

*3.6. Social Validity*

*3.6.1. Teacher social validity*

To gauge teachers' opinions of the RR platform also its assessments of the intervention's advantages for children's reading abilities, investigators sent applications to participants' classroom instructors. The instructors and researchers gathered to discuss the results of the surveys thereafter.

*3.6.2. Student social validity*

Students were asked to answer an oral interview after the research on their feelings about taking part in the work, the elements they found to be most appealing, along with what they might change about the intervention. To reduce bias in responses, an additional investigator performed the interviews.

*3.7. Interobserver Agreement (IOA)*

All project stages included training for two Graduate Assistants (GAs). Every single GA got turns acting as the additional observer to confirm the information gathered by the initial observers. During every individual involved in the experiment, another witness participated for a minimum of 50% of the intervention, generalization probes, baseline, maintenance, training, and social validity assessments. The sum of each contract was split by the sum of all consents and disputes, followed by multiplication by 100 to arrive at the actual deal. The following were the average IOA estimates for each of the five students who took part in every phase of the treatment. IOA was 98.9% throughout baseline CR and AIMSweb passing, and it was also 98.9% throughout therapy inquiries, 99.4% after generalization inquiries, 98.2% throughout intervention average approval, and 99.7% during maintenance.

*3.8. Treatment Integrity*

Following performing baseline, education, intervention, and maintenance, a second witness observed every investigator for a minimum of 70% of the supplementary tests using a prewritten questionnaire. Employing a pre-written

checklist, a second witness watched each researcher. DIBELS Pre- and posttests, CR and AIMSweb baselines, and ongoing servicing will follow. The distribution of the information is as outlined below: pre and subsequent tests at 100%, baseline data at 100%, including CR and AP, therapy probes at 80%, intervention probes at 78.9%, generalization probes at 82.1%, and follow-up data at 100%.

## 4. Results

### *4.1. CR Fluency and Maze*

Baseline, intervention, and maintenance ORF improvements for CR and AP for students are shown in Figure 1. After the intervention, all students exhibit a rising trend in their ability to read new CR sections, compared to their baseline performance. Significantly, Jerry and Noah's reading information on CR passages showed nearly no overlap between the two data levels, suggesting a positive intervention impact. Similar rising tendencies were seen for maze scores on CR sections. The percentage increase and indicated ORF and maze ratings for CR passages from pre-intervention to post-intervention are shown in Table 2.

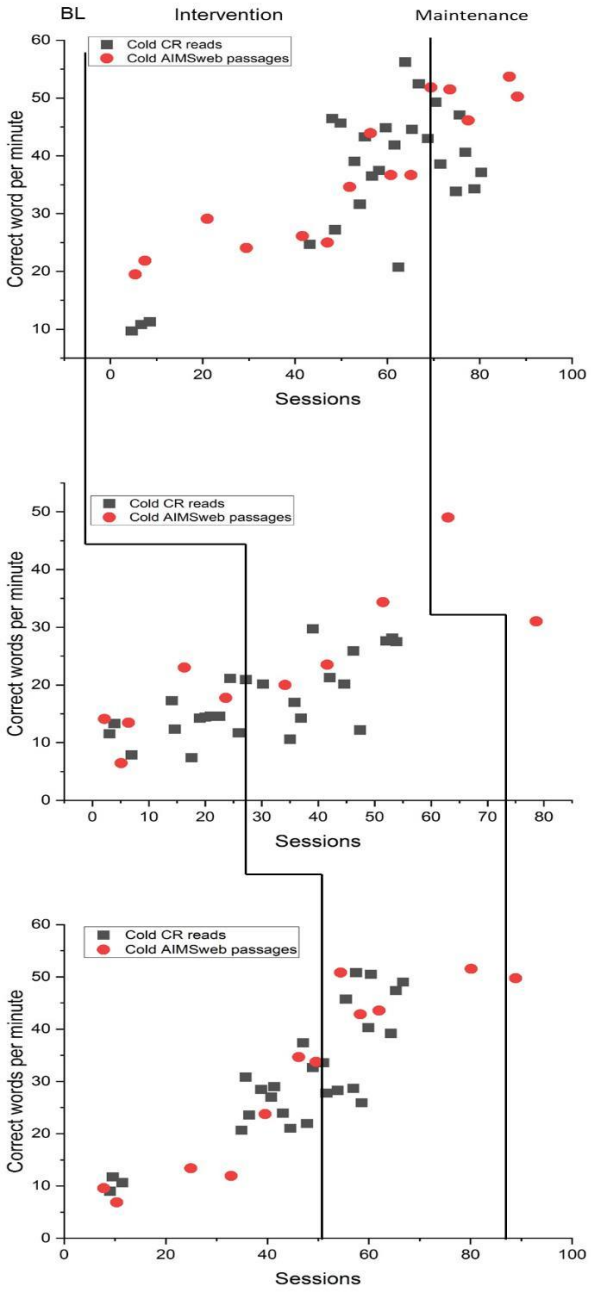


**Figure 1** Correct phrases per minute for Tiers 1 through 3 in a single session.

**Table 2** Student Development Based on Baseline and Intervention Passages Scores.

| | Mean Correct responses on CR maze | | | Mean CWPM on CR passages | | |
|---|---|---|---|---|---|---|
| Student | BL | BL | Int. | PI% | Int. | PI% |
| Noah | 2.1 | 10.4 | 42.1 | 300.1 | 14.3 | 562 |
| Tristen | 3.1 | 11.8 | 19.1 | 55.9 | 8.5 | 144.4 |
| Jack | 4.4 | 3.1 | 15.4 | 382.1 | 5.4 | 23.11 |
| Jerry | 2.5 | 10.6 | 35.6 | 249.10 | 12.6 | 397.7 |
| Mia | 2.1 | 12.09 | 20.6 | 67.9 | 8.9 | 292 |

*4.2. AIMSweb Fluency and Maze*

Students improved at a comparable rate on their CR passage and maze exams as they did on their AIMSweb generalization inquiries and exams. All of the students improved significantly, particularly Tristen and Jerry who did not have overlapping measurements from baseline to intervention. Considering a single overlapping measurement from baseline to intervention, Noah similarly demonstrated a significant improvement. The students outperformed their baseline fluency scores on maintenance probes, which were administered two weeks and one month following the conclusion of the training by using AP (shown in Figure 1). Every student's maze test during maintenance showed no overlap between baseline and intervention (shown in Figure 2). Table 3 displays the percentage gains for students on the maze and passage examinations on AIMSweb. Percentage gains of greater than 100% were seen for all students.

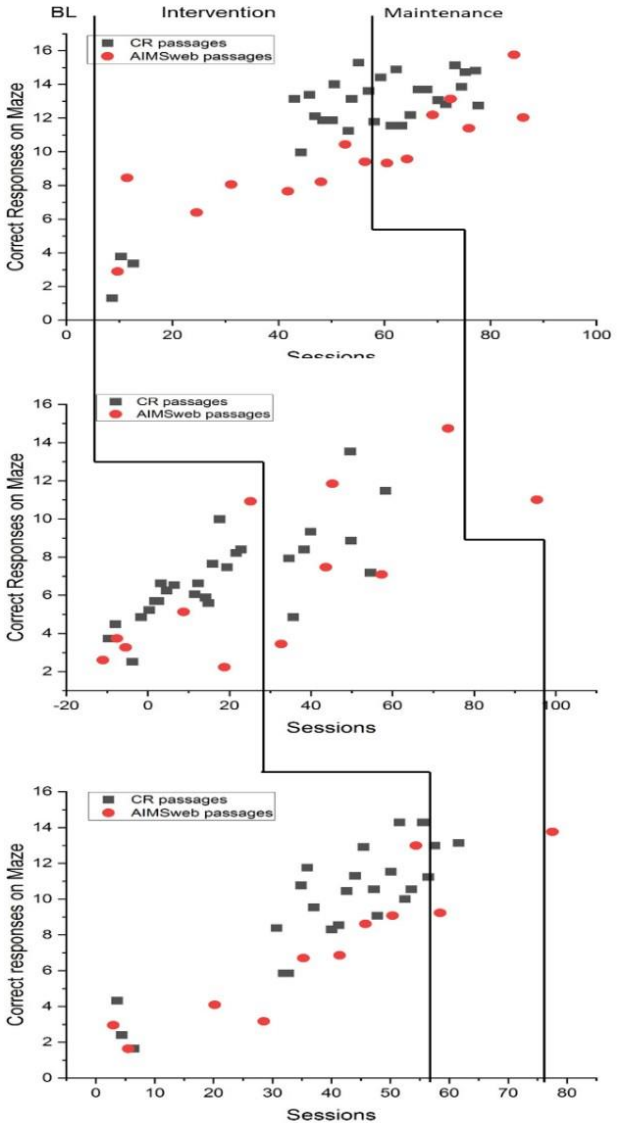


**Figure 2** Correct answers on understanding of a maze per session.

**Table 3** Student improvement utilizing baseline and intervention scores from AP.

| | **Mean correct responses on AIMSweb maze** | | | | **Mean CWPM and percentage of increase on AP** | | | |
|---|---|---|---|---|---|---|---|---|
| Student | BL | BL | Int. | PI | M | Int. | PI | M |
| Noah | 7.4 (0-9) | 21 (4.31 | 48.6 (39.56) | 134.6 | 57 | 10.9 (8-14) | 57.8 | 16.5 |
| Tristen | 3.9 (3-4) | 12.9 (8-16) | 26.8 (20-39) | 119.9 | 45 | 8.4 (3-13) | 135.5 | 14.6 |
| Jack | 6 (3-8) | 7 (4-11) | 16.9 (9-27) | 165.4 | 25 | 5 (4-9) | 18.8 | 4 |
| Jerry | 5 (4-8) | 9.5 (7-14) | 39.9 (22-45) | 167.4 | 25 | 4.8 (3-8) | 18.7 | 4 |
| Mia | 1.4 (0.5) | 10.5 (6-15) | 22.5 (14-33) | 132.11 | 44 | 8.2 (6-15) | 502 | 12.6 |

*4.3. DIBELS*

All students showed moderate to considerable progress on the DORF examination, as demonstrated in Table 4 when their increase in Correct Words per Minute (CWPM) and percentage growth were taken into consideration. Jerry stands out among the group because he increased the reading from 8 CWPM at the start of the year to forty-four CWPM at the conclusion.

**Table 4** DIBELS Next values on ORF for BOY and EOY.

| | EOY | | BOY | | |
|---|---|---|---|---|---|
| Name | The median for raw scores | Level of risk | The median for raw scores | Level of risk | Percentage evolution from BOY |
| Jack | 13 | Well Below benchmark | 6 | NA | 200.0 |
| Jerry | 45 | Below benchmark | 9 | NA | 452.0 |
| Noah | 48 | Below benchmark | 12 | NA | 352.0 |
| Mia | 39 | Below benchmark | 10 | NA | 365.6 |
| Tristen | 35 | Below benchmark | 12 | NA | 235.0 |

*4.3. ROI*

According to these predetermined standards, the anticipated development of four out of five students was much higher. The statistics in Figure 3 show that the student's reading fluency was higher than would have been anticipated without focused instruction.

*4.4. Social Validity*

The RR software was favored by all of the students, and they all expressed a desire to keep receiving intervention in the years to come. Additionally, several commented that their favorite tales to read were the CR portions. All of the students said that they thought the curriculum had helped their reading. The reading progress of the students was also well-received by classroom instructors, who said they planned to use RR in the future.

**5. Discussion**

A practical relationship between the participants' ORF on new CR sections and the RR protocol was clearly shown in their responses, however, there was some variation. For instance, a few students' CR passages included overlapping information. Initially, the student had trouble maintaining his or her reading pace and was regularly griped about being to read for such extended periods. However, as the trial progressed and there was clear evidence of improvement, Mia spoke favorably about her advancement and showed more concentration and effort during the cold readings. Tristen maintained a single overlapped CR information point on an entire sentence with several unintelligible words, including (Larkish and Jamal.) Jack made slow but steady progress while working with several overlapping Information points. Jerry and Noah, however, did not have any overlapping Information points and showed a significant improvement in reading confidence between the baseline and intervention. The analysis of the maze evaluations also showed the students' development. Noah and Jerry performed the best on the CR maze comprehension tests, earning eight perfect scores, as they did on the other measures. The fact that these passages were only test questions may be one reason why students were not exposed to the material via the repeated reading process. Particularly accurate in terms of the fluency information, since the AIMSweb information

proved to have somewhat greater fluencies than the CR data and kept them during maintenance purposes. On the other hand, on AIMSweb, the total maze knowledge ratings were significantly lower than the actual CR sections. One explanation relates to every CR paragraph had progressively difficult words or phrases that students were still learning in first grade, but the CR passages also had supplementary material that was individually significant, which helped students understand the material better on the CR mazes. All participants improved steadily on their DIBELS Next tests, with 4 of the 5 showing significant improvements and Jack showing just modest improvements. The only student still in the danger category of (Well below Benchmark) was Jack. Jack was obedient and persevered in the intervention, but he had a very hard time remembering the fundamental knowledge required to complete scholastic activities. For instance, each youngster was given an ID with their laptop log-in details, which they all rapidly logged into memory. But during the intervention, Jack continued to copy from his card since he had forgotten his password. The other four students improved their reading fluency quite a little. For instance, Jerry made tremendous progress from eight CWPM to 44 CWPM; he is now only three CWPM away from the benchmark. On the end-of-year evaluation, Noah also showed outstanding growth, going from 10 CWPM to 44 CWPM, falling three words falls short of the standard. The statistics shown on the ROI graphs in Figure 3 are as, even more, compelling of the students' development in literature. Four of the students achieved very excellent to moderate development, surpassing the portion of predicted performance had they not received the intervention or evaluating benchmark to predicted and real development, approaching benchmark. At least two of the student may have exceeded the benchmark with a longer, stronger intervention. Jack kept up his very slow reaction rates, showing no sign of development. The participants' improved ORF on reading tasks lends credence to the idea that effective therapies may and should be employed with students who are younger than the age of three. These first graders managed to make significant progress and generalization of their knowledge, which offers some proof that efficient, early assistance might improve children's knowledge and perhaps stop greater performance disparities from developing in the future.

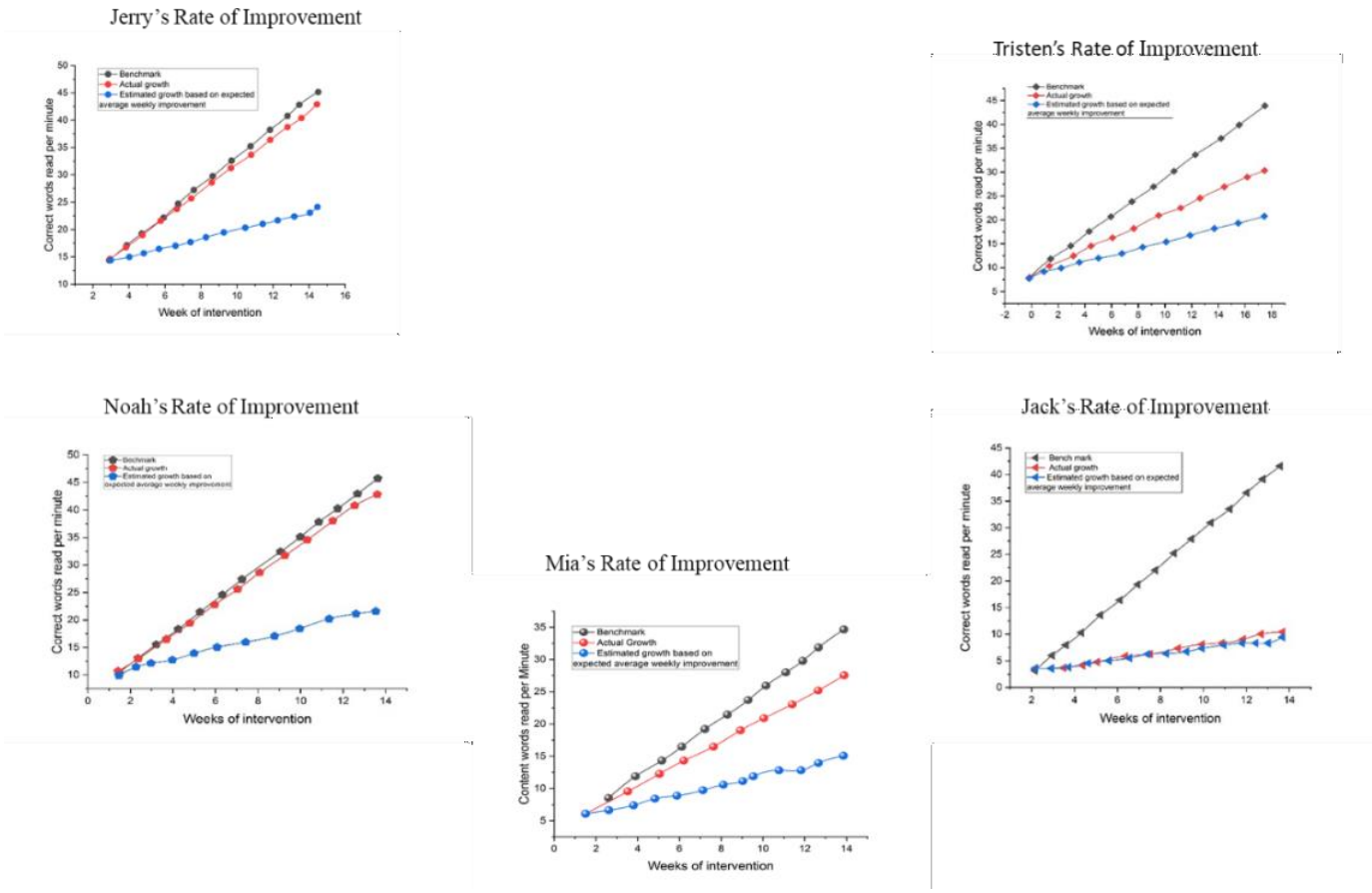


**Figure 3** Improvement rate for all participants.

## 6. Conclusions

The outcomes of this research corroborate other studies showing that RR may successfully be employed to enhance comprehension and fluency in reading for first-graders in urban settings who are at risk for reading failing. Information displaying every student's ORF and comprehension ratings revealed an operational connection between RR and reading results. The ROI graphs, which indicate literacy increase rates for four of the five participants that are much greater than those anticipated, encourage these conclusions. In addition to the information that was gathered, anecdotal comments

indicated that the participants' trust in reading and effort had increased. According to social validity assessments, students were motivated to use RRI. Student participants showed that they could use the program and adhere to the instructions on their own with little assistance from personnel. For a multi-layered reading program that helped first-graders read better, RR used methods supported by evidence. Having this strategy, the risk of reading for first-graders in urban schools with constrained assets might be reduced. It will be crucial to keep developing this software technologically to make sure that it can be used in regular classroom and school settings.

**Ethical considerations**

Not applicable.

**Declaration of interest**

The authors declare no conflicts of interest.

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Exploring the Intersection of Social Science and Humanities: Current Research and Challenges

# Fostering concentration and engagement of peer mediators in primary classrooms as joint concentration agents

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**Abstract** The concept of joint concentration agents suggests that kids actively promote and sustain Fostering Concentration (FC) and engagement between their classmates. Fostering concentration and engagement in the current setting means establishing an atmosphere that motivates kids to pay FC and actively engage in educational activities. This might include a variety of tactics, approaches, and interventions that educators use to improve their students' capacity for sustained FC and engagement throughout class activities. Primary Classrooms (PC) strongly emphasize social and emotional development in addition to intellectual study. Students pick up social skills such as cooperating, sharing with peers, and developing empathy. Kids with developmental difficulties, such as Autism Spectrum Disorder (ASD), risk being excluded from other kids of the same age. Additionally, studies show that focused therapies and support benefit kids with ASD, even in inclusive environments. Joint Concentration (JC) has been recognized as a critical talent for improving period-suitable social skills and announcements. JC is a joint involvement between two persons on a third item or event. An increasing corpus of research describes successful interventions on JC skills for kids with ASD; despite this, few studies document the results of an intervention that uses a natural change agent. In the current research, Response to Joint Attention (RJA) behaviours shown by seven pre-schoolers with ASD was assessed using independent concurrent multiple baseline designs. The Peer Mediators (PM) can carry out a direct interference with accuracy, and the seven peers' overall RJA behaviours improved as a result of the intervention, as did the number of peer bids and replies to those bids.

**Keywords**: fostering concentration, joint concentration, ASD, peer mediators, RJA

## 1. Introduction

In Numerous factors, such as students' motivation and interest in pursuing studies, may be used to predict academic performance. Student engagement and motivation levels, unfortunately, fluctuate often during the years spent in school. The scenario is particularly true as pupils go from elementary to middle school. Consequently, it is crucial to look into the key elements that affect students' high-quality motivation and engagement, especially before they graduate from elementary school. Student engagement and inspiration have been investigated and studied from various theoretical perspectives, involving expectancy-value theory, goals theory, and self-determination theory (Zhou et al 2019) Numerous individual, pedagogical, institutional, and societal elements at home and school impact students' academic development. The interactions between kids and adolescents and educators, peers, and parents are among the most important, as shown by decades of study. Still, surprisingly little study has looked at the connections between parents, teachers, and peers, despite decades of research showing that these interactions play essential roles (Skinner et al 2022) Pedagogical strategies, educational methods, and student assessments of teaching practice have traditionally been the subject of systematic measurement of the student experience. Institutions can now quantify and track the degree to which the institution fulfills the student's baseline expectations by measuring attribute-level assessments of the student experience (Bowden et al 2021). The concept of learner engagement has received more attention during the past twenty years. Student involvement has been linked in educational psychology studies to better academic results, such as higher grades, perseverance, and graduation rates. The engagement has so been seen as the highest point of education. Engagement constitutes a relatively new but expanding area of study in Applied Linguistics. The bulk of empirical study that has been done so far focuses on engagement as a state of participation and attention in activities, and it is primarily based on prior work in educational psychology (Sulis 2022) Student engagement is the amount of active engagement, involvement, and attention shown by students in the educational activities and learning process. It includes as motivated, focused, and dedicated students are towards their studies as well as the level of interaction is having with their professors, classmates, and course materials. Students actively

participating in their education are excited to learn, eager to engage in class discussions, and quick to ask concerns and get clarification as necessary. Students take responsibility for their education, establish objectives, and actively seek advancement chances (Wong and Liem 2021). Primary classrooms are called joint concentration agents because they serve as learning spaces for instructors and students to engage and concentrate on relevant academic activities actively. Teachers work as facilitators and mentors while students actively participate in their education in these classrooms. In order to accomplish the learning goals, instructors and students collaborate, emphasizing shared responsibility and involvement. Teachers create activities and courses in these classrooms to promote student engagement and critical thinking. It offers students engaging, relevant learning opportunities that relate to their interests and past knowledge (Reinsalu et al 2022). Education comprehension Engagement actively engages students in the learning process by promoting active involvement and creating a thorough comprehension of the subject matter. It highlights the need for pupils to move beyond rote learning and cultivate their critical thinking, creativity, and problem-solving skills. This method acknowledges that kids learn most effectively while motivated and engaged enough to explore the world independently. Student connection is essential for fostering understanding and participation in the classroom. It entails establishing a collaborative learning space that students may exchange ideas, ask concerns and get feedback (Crasto 2023). Engagement In primary classrooms, PMs operate as joint concentration agents and make a concerted effort to create a friendly and collaborative learning environment. The aim of these mediators, that are often students themselves, is to encourage peer interaction and cooperation. Educators could lead conversations in groups, promote peer-to-peer problem-solving, or start group initiatives to promote collaboration and teamwork. Engagement PM actively creates a positive and effective learning environment (Katiba 2020). These mediators are aware of the importance of focusing on learning. Experts collaborate with instructors to put techniques into practice that improve engagement and keep kids' attention. They capture students' attention and make learning more engrossing and exciting using diverse strategies, including interactive exercises, visual aids, and multisensory approaches (Malmberg and Martin 2019). An environment that actively stimulates student involvement, interaction, and interest in learning is an engaging learning environment. Students feel inspired, empowered, and appreciated in this vibrant and accepting environment where they may actively participate in their education. An engaging learning environment emphasizes collaboration and involvement. The chance for students to collaborate, have group discussions, and take part in cooperative learning exercises is provided (Rojas-Rodríguez 2021). The collection of evidence that supports beneficial interventions on JC skills for kids with ASD is rising steadily. Despite this, a surprisingly small number of papers discuss the positive effects of interventions that internal agents mediate. The study, independent simultaneous various the beginning design, is used in order to carry out an analysis of the RJA behaviors that were shown by eight children that had been given a diagnosis of ASD.

## 2. Literature Review

The Several academic issues may be remedied at the secondary level by increasing student participation. Data from the past emphasize the importance of comprehending as young kids interact in school. The current systematic review aims to offer research on elementary school student's involvement in their studies. The conceptualizations, dimensions, and measurements of school involvement that were employed were examined, and the relationships to the findings were reviewed (Martins et al 2022). Song and Kim (2021) assumed that interactive self-regulation scaffolding improves self-regulated learning abilities, course engagement, and learning performance for online learners. The intervention employs a dialog method with an intelligent conversational agent to support learners' self-regulated learning. According to the findings, the group that was given scaffolding had better results in improvements in their degree of self-regulated learning than the control group did. Wang et al (2020) provided an integrated theoretical view on engagement using a development-contextual approach, highlighting that involvement results from dynamic development and interpersonal processes, including transactions across much ecology. The psychological, cognitive, and social pathways that underlie the many pathways underpinning the development of young participation are presented in a nuanced and complete manner by the integrated model of engagement. Russell et al (2021) examined the experiences of high school-aged newly arrived immigrant and resettled refugee kids in four Arizona and New York schools. The study uses a combination of research techniques to look at these pupils build a sense of community and civic identity, as well as schools affect the growth and development of their students. As presented in an update of the research, the consequences of acquiring an understanding of the science of development and learning are highlighted in this article for school and classroom practices. A developmental systems framework synthesizes evidence from the learning sciences and various branches of educational research regarding tried-and-true methods that foster connections and educational opportunities required to advance kids' wellbeing, healthy development, and mobile learning (Darling-Hammond et al 2020). Sjöberg and Brooks (2020) investigated the configuration of student participation in problem-solving activities and the creation of digital game ideas. The research is based on a scenario involving game creation activities used in a workshop with school kids. Using interaction analysis and elements of content analysis, game design activities, including the participating kids, creative materials and technology, and the kids' behaviors and interactions are all analyzed. Nuttall et al (2019) explored the dynamic interaction among cultural resources and the object motivations discovered during teacher interviews, theorizing the remediation of teachers' curricular decision-making. It comes to a close by considering the implications for upcoming professional development projects that seek to alter

early childhood education curricula by adding fresh cultural resources. Konijn et al (2022) examined social robot tablets' performance, engagement, and pleasure benefits for language acquisition. New technological solutions are needed to address shortages in basic education. Studies indicated that teaching involving a social robot instead of a tablet resulted in faster learning increases over time. Kids having practiced telling stories using a machine were more enthusiastic and interested in the job. All three wellbeing indices were shown to be strongly predicted by parental conversations about difficulties, and it was discovered that genuine self-esteem mediated all of these associations. These findings are consistent with the notion that talking to kids about difficulties while raising them fosters their resilience and general wellbeing (Boulton and Macaulay 2022). More data should be on the primary instructors' peer cooperation tactics. Despite this, the substantial body of existing peer cooperation research is heavily weighted toward suburban and urban student results. The fact that the voices of teachers that design educational experiences for kids in rural areas have been excluded mainly in the existing body of peer collaboration research is a concern. This dissertation focused on North Carolina's rural primary school instructors using peer collaboration practices (Clark 2019). Kos (2023) examined peer support among English as foreign language students in grade 5 that interacted during regular classes. The current research aimed to determine how many young students assist one another while working on lexical phrase assignments in class. It used a mixed methods research design and was based on sociocultural theory. Hong and Matsko (2019) evaluated the impacts of teacher mentoring; this article proposes a multidimensional framework emphasizing interactions between formal mentors and new teachers as well as the context in which these interactions occur. The findings also show that although poorer leadership may reduce the potential advantages of high-quality mentoring, more excellent principal leadership may shield teachers from needing access to mentors or mentors of high caliber. Although parental participation is one of the primary forms of social support for kids' academic accomplishment and school engagement, research on the connection between parental involvement and student engagement could be more robust in the existing review literature. According to this pattern of findings, more research on particular parental participation strategies that can encourage student engagement from various stakeholders is urgently needed (Yang et al 2023). Lakkala et al (2021) investigated over and contrasted the cooperative methods instructors in four schools in Austria, Finland, Lithuania, and Poland used to encourage their pupils. The study made use of inters professional collaboration ideas as a conceptual framework. The researchers subjected the study's results to a theory-driven thematic analysis. According to the research, encouraging supervision is essential for encouraging overseas doctoral learners to pursue innovation, creativity, and good citizenship. The results from these groundbreaking researches will motivate academic supervisors to alter guiding and mentoring practices for doctorate candidates and will assist higher education administrators and policymakers in reviewing current doctoral program administration and delivery methods (Kos 2023).

## 3. Method

The approach creates an accepting and encouraging learning atmosphere in the PC, defines clear expectations, and offers exciting learning resources. To refocus their FC and boost engagement, PMs use various techniques such as verbal prompts, visual aids, and cooperative learning frameworks. The strategy's efficacy is regularly monitored and evaluated, allowing for necessary improvements. PM is used in this strategy to encourage cooperation and make learning more interesting for all kids.

### *3.1. Recruitment and Participants*

In the northwest corner of the United States, the Pacific Northwest, accommodating preschools for kids with impairments were used to find eight kids between the ages of 4 and 6 had been recognized by their preschool instructor as having ASD or being at risk of developing it. To achieve the inclusion requirements of the present research, kids falling into this category did not need a valid special education certificate or an official diagnosis of autism spectrum disorder. Target kids qualified if parents met the following criteria: spent the bulk of the educational day in an environment that accepted every kid; had clinically significant low levels of RJA behaviors as assessed by the Early Social Communication Scales (ESCS); and participated in a class for at least two days per week with good attendance. The demographic information of the target kids is shown in Table 1.

**Table 1** Demographic Information of Target Kids Participants.

| Participant | Gender | Race/ethnicity | ASD diagnosis | CARS-R | Age | RJA | Peer | Class |
|---|---|---|---|---|---|---|---|---|
| Oliver | M | Hispanic/Latino | Educational | 32 | 5.0 | 0 | Lucas | B |
| Emily | F | Caucasian | Educational | 39 | 4.0 | 0.42 | John | B |
| Arthur | M | NR | Teacher report | 23 | 4.1 | 0.35 | Martin | A |
| Aiden | M | NR | Educational | 38 | 4.2 | 0.28 | Mario | A |
| Trevor | M | Caucasian | Teacher report | 23 | 4.5 | 0.60 | Jacob | C |
| Jason | M | Hispanic/Latino | In evaluation | 32 | 4 | 0.43 | Michael | D |
| Quinn | M | Caucasian | Educational | 33.5 | 4.4 | 0.50 | Theo | D |

The PM was requested to take part in dyads with the target kids. Only one dyad per peer was engaged. PM participants were considered to have met the following criteria: ESCS values within an average divergence of the signify were carried, scores on the combined FC subscale were related to single standard deviation of the average, and overall scores were higher than those of the target kid; as considered by the JC the subscale of the ESCS, had good RJA and IJA abilities; attended elementary school at least two being a week with satisfactory presence but unavailable in zero to moderate level of demanding activities. Table 2 contains information regarding the demographics of PM.

**Table 2** Demographic Information of Peer Participants.

| Peer participant | Gender | Target Kid | RJA | Age | Class | Race/ethnicity |
|---|---|---|---|---|---|---|
| Michael | M | Jason | 0.95 | 5.2 | D | Caucasian |
| Theo | M | Quinn | 0.95 | 4.8 | D | Caucasian |
| Martin | M | Arthur | 1.0 | 5.2 | A | Caucasian |
| Mario | M | Aiden | 0.85 | 3.7 | A | NR |
| Jacob | M | Trevor | 0.84 | 3.8 | C | Caucasian |
| Lucas | M | Oliver | 0.93 | 4.5 | B | Caucasian |
| John | M | Emily | 1.0 | 3.7 | B | Caucasian |

*3.2. Design*

Two distinct single-case designs were used to assess the impacts of the intervention package: concurrent multi-base throughout four dyads design and simultaneously repeated explore across dyads design. The first design complies with What Works Clearinghouse (WWC) standards. The second design offers more demonstrations while meeting WWC requirements with certain restrictions. The only AI that went into the learning process was the first author that is now pursuing a doctorate in better childhood special education and has five years of expertise implementing treatments for children with autism spectrum disorders.

*3.3. Setting*

In the primary classroom, interactions with the PM were held during middle period at an educational station. Learning stations were designated spaces in the PM, usually dedicated to a particular developmental topic. Kids may choose from various activities; many were connected to a particular theme unit during free play in primary classrooms. All of the PM was set up like conventional primary ones, with tiny spaces for themed play areas, kid-sized furniture, and items acceptable for kids of that age.

*3.4. Materials*

All of the sessions involving the adult intervention included the introduction of novel items to the setting as a stimulus for shared FC interactions. To reduce the impact of preference effects, items were rotated in three groups, including one light-up item and one goofy plush animal with a flat or paper object. The PM was told to choose a place for the artifacts after the intervention phase had begun. The Adult Interventionist (AI) would relocate the stimulus if the PM chose a location that was out of sight or too near to another object, following prior item placement rules. All participants' preferences for the combined JC stimuli and games were arranged in a hierarchy. Games and stimuli with a mid-ranking were selected.

*3.5. General Procedures*

Every session was allocated a total of thirty-five minutes. During each 30-minute session, the AI met with the target kid for ten minutes, followed by a seven to ten-minute meeting with the PM interventionist. The previous ten minutes of the 35-minute assembly were spent in the target child's primary classroom with a peer mediator's interventionist. Together, the stimuli were set up outside the hallway and within the primary classroom so the target kid and primary classmate could see them. The AI research was nonetheless carried out even without a peer mediator.

*3.5.1. Baseline with AI*

The AI did not provide systematic baseline teaching, just sporadic shared FC bids. In particular, the kid was interfering and requested shared FC while playing with the kid at a frequency of around once every three to four minutes. Bids consisted of a simple point and gaze change in the direction of the item or event, together with a spoken instruction. If the kid responded to the shared FC request, the interventionist made a short remark on the item but did not give any further predetermined consequences.

*3.5.2. Baseline with PM*

Both the target kid and the PM took part in an activity that took place in the JC center of the PC during their baseline sessions. The kid's interventionist was there, but she simply engaged among the dyad to ensure everyone stayed in the agreed-upon space and settle any disputes. During baseline, the PM was not encouraged to indicate the novel items to the target kid; nonetheless, data were gathered on sporadic occurrences of shared JC initiations.

*3.5.3. Intervention with an adult interventionist*

A hierarchy of the smallest amount to most prompts and nutrition corroboration were used to teach JC new skills. The ladder of prompts included a gaze change, a look transfer and point, a limited physical prompt, and a complete physical prompt. Two to four-time delays were employed by the interventionist. Naturalistic teaching techniques were used throughout the intervention sessions, such as staying feature face with the kid and building on his or her benefit. Once the youngster participated in the shared FC behavior chain, a chosen consumable was presented.

*3.5.4. Peer mediator's training*

The interventionist's prompting hierarchy was adjusted and included in the social narrative. The AI also exhorted the PM to demonstrate to me the way you will share your companion you will see before teaching them to ask for shared FC by modeling, feedback, social praise, and physical reinforcement. These sessions, lasted between 6 and 11 minutes, were placed before each peer-mediated intervention session.

*3.5.5. Peer-mediated intervention*

Following 10 minutes of adhering to the adult interventionist's intervention, the peer mediator's intervention sessions were held in the same setting as the baseline peer mediator's intervention sessions. The AI was there to facilitate play, just like at baseline. The professional interventionist verbally encouraged the PM to try a collaborative FC every 4 to 5 minutes if required.

*3.2. Measurement and Reliability of Responses*

*3.2.1. Adult intervention data*

Data on the goal kid have converted percentages of interventionist offers that elicited a prompted or spontaneously provided JC reaction across an 11-min period, with bids offered around every 3 to 24 minutes. The proportion of bids having a kid's RJA was calculated by dividing the number of AI offers with a JC reaction by all of the responder bids from children and multiplying the result by 100. Data were gathered about the number of interventionist prompts required to elicit a response from the target kid and the topography of simultaneous behavior. Within each instruction session, least-to-most prompting was used as required. The least invasive prompt was a change in gaze with a verbal description followed by gestures, partial physical prompts, and complete physical prompts.

*3.2.2. Peer mediator's intervention data*

Data on the target kid's IJA frequency from PM and the kid's bid geography were graphed. Additional data on the task integrity of PM was acquired using the item task fidelity checklist. Data were acquired to answer the PM bids using the same operational standards and methodologies as in the conversation with the kid's interventionist.

*3.3. Procedural and treatment fidelity*

*3.3.1. Interventionist procedural fidelity*

An impartial observer recorded the interventionist procedural integrity for each session using the author's checklists. Interventionist procedural fidelity data were gathered at baseline. According to the baseline task fidelity assessment, the interventionist was not using instructional techniques, which also included requests for shared FC. The interventionist procedural fidelity monitoring system ensured that the appropriate prompting hierarchy, time delay, and reinforcement techniques were used. PM ' training utilizing the social story had 100% interventionist procedural integrity.

*3.3.2. Peer mediator's interventionist treatment fidelity*

At baseline, the treatment fidelity score for each participant across all sessions was 15%. The peer mediator's participants' average participation rate throughout the intervention was 78%.

*3.4. Social Validity*

The author developed the Intervention Acceptance Score Form Revised to assess social validity. After the intervention, instructors completed the TARF-R, a short Likert scale questionnaire. Teachers were asked to judge the usefulness, acceptability, and practicability of these intervention objectives, processes, and results.

### *3.5. Data Analysis*

Line graphs were examined visually for vertical analysis, instant effect, level, trend, variability, and overlap. Following visual assessment, Tau-U was calculated utilizing the singlecaseresearch.org calculator for each A-B comparison. Tau-U is a no overlap metric with limited control over the baseline trend. Within the plots, a weighted, averaged Tau-U was produced.

## 4. Results

The method establishes clear expectations, fosters an inviting and encouraging PM inside the computer, and provides engaging learning tools. PM use various strategies, including verbal reminders, visual aids, and cooperative learning frameworks, to redirect their FC and increase participation. Regularly monitoring and evaluating the strategy's effectiveness allows for any required adjustments. This technique uses PM to promote collaboration and make learning more engaging for every kid.

### *4.1. Results of Sessions with the AI*

The data from kid's interventionist sessions for the primary intent are shown in Figure 1. Data for all four subjects showed changes in level and trend without any overlap, indicating a significant functional relationship. Arthur autonomously replied to an average of 72% of requests for shared FC throughout the intervention, compared to 36% at baseline.

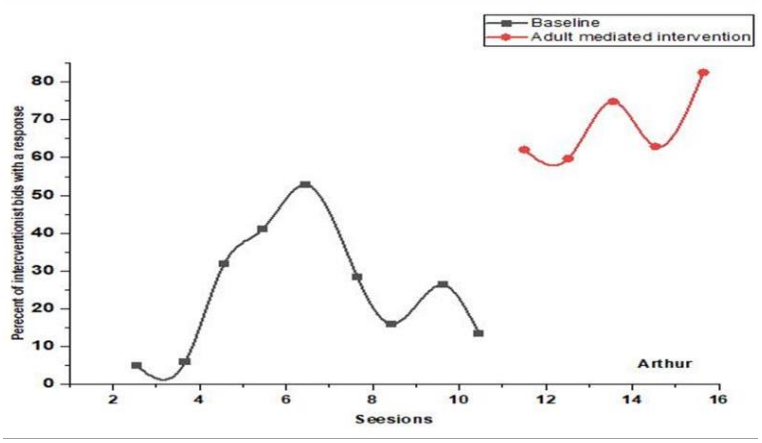


**Figure 1** Target kid's Response to AI bids for Arthur.

The baseline data for Emily showed a preliminary rising trend. The mean baseline score for Emily was 32%. Emily's autonomous Response immediately improved after the intervention, with an average of 82% of requests for collaborative FC (Figure 2).

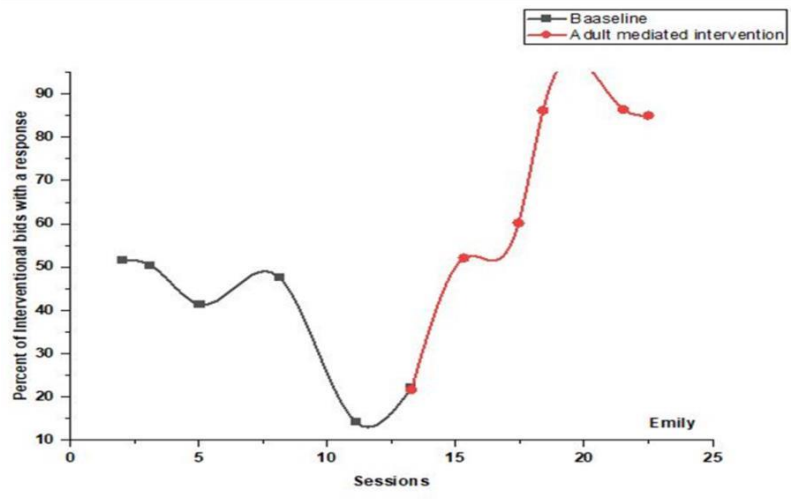


**Figure 2** Target Kid's Response to AI bids for Emily.

The statistics for the second design's AI session, with three participants, are shown in Figure 3 and Figure 4. This multiple-probe design's visual analysis revealed three fundamental impacts simultaneously. Data from the baseline and intervention periods did not overlap. Initial analysis of Aiden's baseline data revealed a definite upward trend. Still, a declining trend was seen before the intervention. The average RJA behavior level for Aiden at baseline was 36%. Aiden's independent RJA was at a mean of 72% after the intervention (Figure 3).

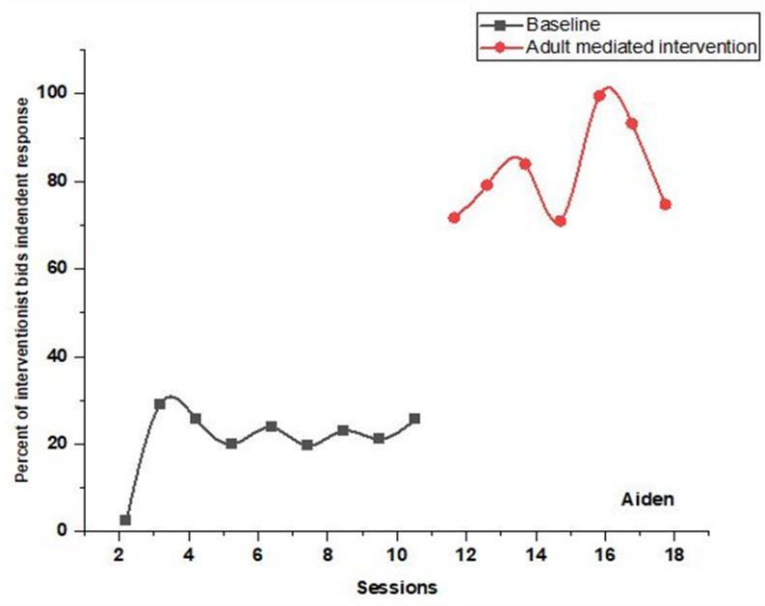


**Figure 3** Target kid's Response to AI bids for Aiden.

At the beginning of the study, Trevor had a high first independent response rate, with a mean of 43%. After the intervention, the overall average for Trevor's statistics was 73% (Figure 4).

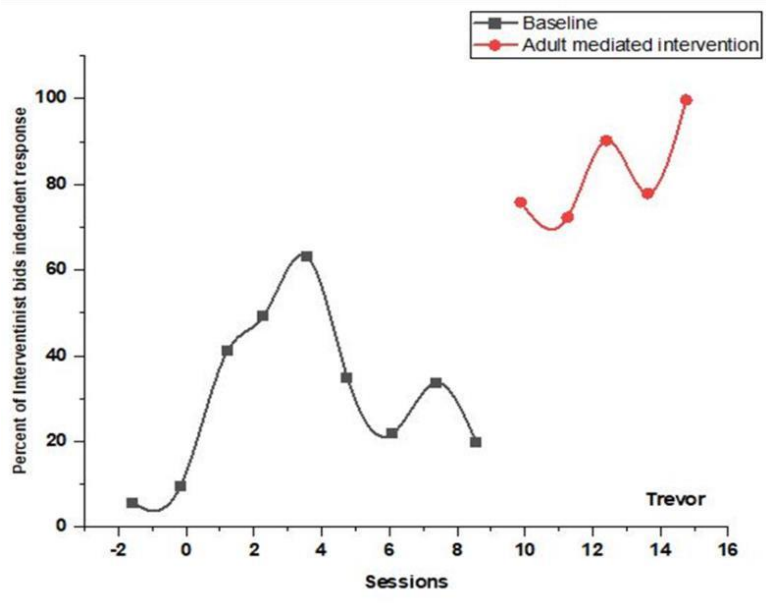


**Figure 4** Target kid's Response to AI bids for Trevor.

*4.2. Results of Peer-Mediated Sessions*

In the baseline, Arthur's Response to the information provided by the PM was at zero levels. After the intervention, Arthur had a mean response to the peer mediator's bids. John submitted no proposals for the shared FC pool during the baseline period. As a direct result of the intervention, John now initiates between three and five times during each session, with a session-to-session average of four times (Table 3 and Figure 5).

**Table 3** Numerical Outcomes of Response to PM Bids for Arthur.

| Sessions | Percentage of peer mediator's bilds with a response | |
|---|---|---|
| | Arthur | Peer-mediated intervention |
| **1** | 61 | 56 |
| **2** | 90 | 88 |
| **3** | 50 | 58 |
| **4** | 38 | 98 |
| **5** | 61 | 63 |
| **6** | 38 | 63 |
| **7** | 75 | 40 |

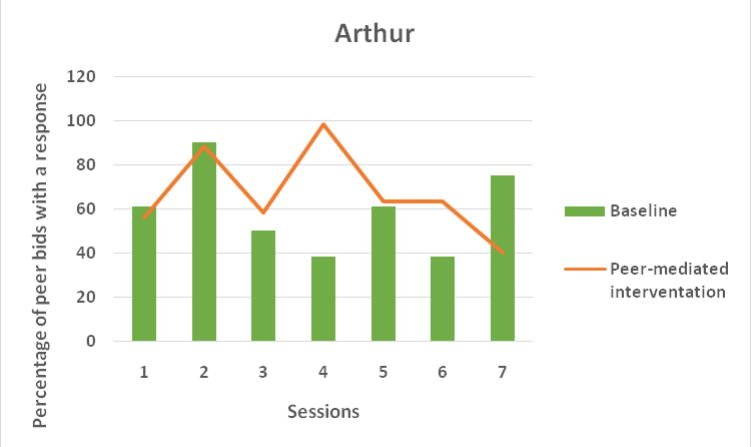


**Figure 5** Numerical outcomes of Response to PM bids for Arthur.

In the baseline, Emily's reaction to the data from the PM was at zero levels. During the intervention, Emily gave a response to every one of the colleague's offers. Emily's reaction to the data from her PM remained unchanged from the baseline level of zero. During the intervention, Emily responded to every bid made by her fellow participant (Table 4 and Figure 6).

**Table 4** Numerical Outcomes of Response to PM Bids for Emily.

| Sessions | Percentage of peer mediator's bilds with a response | |
|---|---|---|
| | Emily | |
| | Baseline | Peer-mediated intervention |
| **1** | 45 | 100 |
| **2** | 50 | 100 |
| **3** | 50 | 100 |
| **4** | 50 | 100 |
| **5** | 37 | 100 |

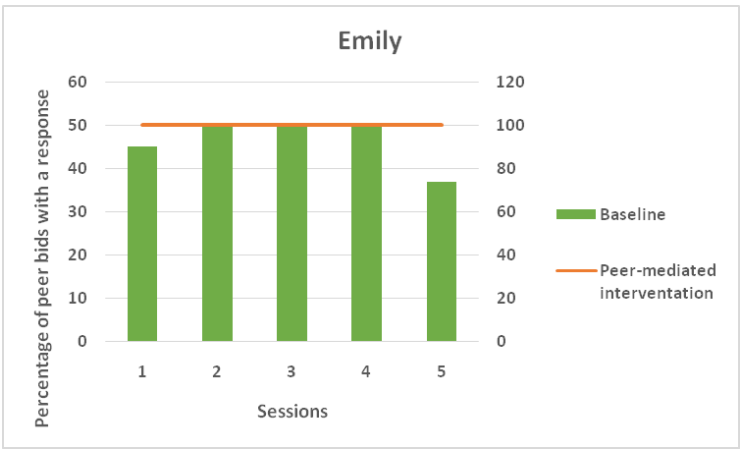


**Figure 6** Response to PM bids for Emily.

During the intervention, Mario made four to five requests for shared FC, including an average of four requests each session. The baseline response from Aiden to the peer mediator's offers was nil. Aiden's average RJA was 82% after the intervention. Jacob made no JC bids during baseline. After the intervention, Jacob offered three to five requests for shared FC, on average three requests each session (Table 5 and Figure 7).

**Table 5** Numerical Outcomes of Target Kid's Response to PM interventionist bids for Aiden.

| Sessions | Percentage of peer mediator's bilds with a response | |
|---|---|---|
| | Aiden | |
| | Baseline | Peer-mediated interventation |
| **1** | 37 | 32 |
| **2** | 60 | 37 |
| **3** | 50 | 100 |
| **4** | 50 | 99 |


**Figure 7** Target kid's Response to PM interventionist bids for Aiden.

The baseline response from Trevor to the peer mediator's offers was nil. The average of Trevor's responses to PM ' bids was 87%. Theo didn't provide any requests for JC during baseline. After the intervention, Theo offered three offers each session for the next three (Table 6 and Figure 8).

**Table 6** Numerical Outcomes of Target Kid's Response to PM interventionist bids for Trevor.

| Sessions | Percentage of peer mediator's bilds with a response | |
|---|---|---|
| | Trevor | |
| | Baseline | Peer-mediated interventation |
| **1** | 60 | 100 |
| **2** | 38 | 100 |
| **3** | 57 | 54 |
| **4** | 38 | 100 |

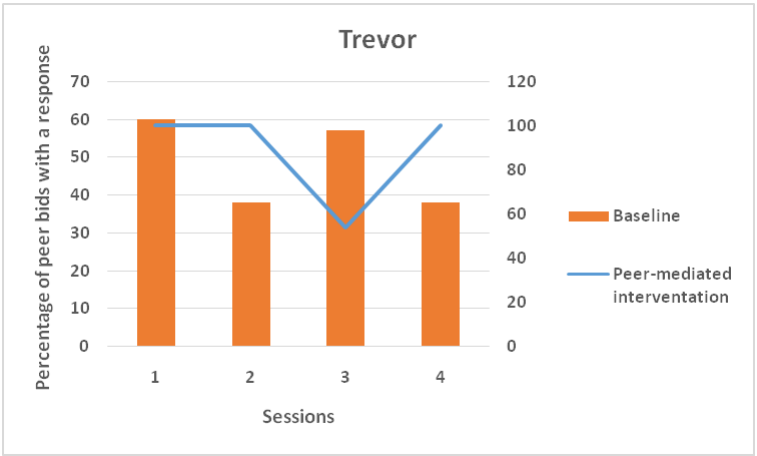


**Figure 8** Target kid's Response to PM interventionist bids for Trevor.

*4.3. Social Validity Results*

Teachers all highly rated the acceptance, viability, and overall success of this intervention. All 17 items for all four primary classroom instructors had an average answer of 4.22 on a 1- to 5-point Likert-type scale, with one being the least acceptable and five the most acceptable.

## 5. Discussion

Theoretically connected to later social communication abilities, early social communication abilities, including social reference, social orienting, JC, and joint respect, are of interest. Despite their significance, evaluation of these abilities declines during childhood in favor of more sophisticated social communication abilities, such as taking turns and mastering play skills. Despite each other, more sophisticated social abilities are apparent; early childhood educators and particular education specialists should consider assessing for JC and additional early social communication abilities. Many kids in preschool with ASD have not yet fully developed JC, and research shows that early development of JC skills is a strong predictor of future preschool performance. Early JC training may be essential for maximizing performance in early childhood environments.

## 6. Conclusion

According to the idea of JC agents, kids actively support and maintain FC and participation among their PMs. One may foster focus and engagement in the current learning environment by creating an environment that encourages youngsters to pay attention and actively participate in educational activities. In order to increase the capacity of kids for continuous FC and participation during class activities, educators may use a range of strategies, techniques, and interventions. In addition to academic learning, social and emotional growth is given much attention in PC. The technique sets expectations, creates an inviting PM within the computer, and delivers compelling learning tools. PM refocuses FC and enhances involvement via vocal reminders, visual aids, and cooperative learning frameworks. The strategy's efficacy may be monitored and adjusted regularly. PM encourages teamwork and makes learning fun for all kids. The possibility for variation in PM efficacy is a drawback of the approach for FC and engagement PM in PC as JC agents. Although PM is chosen according to their proven involvement and attention span, there may be variances across mediators on an individual basis. Future studies might examine the long-term consequences of using PM on kids' ability to focus, levels of engagement, and academic achievement. Such studies would provide insightful information about the approach's potential applicability to different educational contexts and its long-term advantages.

## Ethical considerations

Not applicable.

## Declaration of interest

The authors declare no conflicts of interest.

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