

Exploring the relationship between teacher work engagement and organizational citizenship behavior in early childhood education

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ABSTRACT

The role of teacher work engagement (TWE) is very important in creating positive organizational citizenship behavior (OCB) within the early childhood education (ECE) context. This study hypothesizes the use of TWE structural equation modeling (SEM) with advanced logistic regression (ALR) (TWE-SEM-ALR) model and predict the occurrence of OCB among teachers. When 250 early childhood educators in both public and privates collected a teacher-based questionnaire data, it was observed that the information was gathered in questionnaires. Evaluation was done through experimental means, where an 80:20 train-test splitting was used. The model with the suggested accuracy of 92.4 and precision of 0.91, recall as 0.93, F1-score as 0.92, and area under the curve (AUC) of 0.95 was better than models based on logistic regression, support vectors machines, and SEM-only models. The error analysis and the ablation studies also served to validate the role of every model component, as it was shown that the combination of SEM and ALR greatly minimizes the error in predictions and enhances classification stability. The findings of the effectiveness of the proposed framework in explaining complex engagements-behavior relationships and it has rich implications to educational administrators who wish to improve teacher performance and organizational performance.

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1. INTRODUCTION

Behavior of organizational citizenship has been widely accepted as a crucial factor in making educational institutions work effectively and persistently. In this regard, Gnanarajan *et al.* [1] empirically reported the prevalence of teachers' organizational citizenship behavior (OCB) and determined some key contextual and individual determinants within under-researched cultural settings. This highlights those activities beyond the call of duty are significant in the organizational functioning of schools. In that respect, Nugroho *et al.* [2] also substantiated that OCB is placed with job satisfaction and organizational commitment to being one of the main determinants of manifesting the overall performance of schools, underlining the strategic stance of teachers' discretionary efforts. In that sense, Khandelwal and Nair [3] framed a positive correlation between OCB manifested by teachers and institutional effectiveness in higher education, arguing that citizenship behaviors are evident in teaching-learning processes and extend to the general organizational outcomes of institutions. Practically in school settings, Emirie and Gebremeskel [4] documented how primary school teachers engage in OCB as part of their day-to-day professional activities, thus asserting the importance of such behaviors in different school and educational contexts.

Structural equation modeling (SEM) is now considered to be an effective tool of analysis to model the latent psychological construct and analyze the complicated relationships between variables. Whereas SEM is a good way of explaining causal relationships, its predictive ability is limited when applied alone. On the other hand, machine learning classifiers, including logistic regression, provide good prediction capabilities, but are in most cases unable to explain latent structures of behavioral information. This methodological vacuum underscores the need to have integrated frameworks that incorporate both explanatory and predictive capabilities. In this attempt to overcome this limitation, the current research paper suggests a teacher work engagement (TWE)-SEM with advanced logistic regression (ALR) (TWE-SEM-ALR) model. Through the proposed approach by utilizing SEM to draw latent engagement dimensions and combining it with a sophisticated classification model, the accuracy and strength of the prediction of Teachers' behavior of organizational citizenship are going to increase significantly. By integrating the experimental assessment and comparison and contrasting, this study allows not only to make a step in the development of methods but also to provide a practical contribution to the improvement of teacher engagement on teacher and organizational performance in earlier education on childhood environments.

The scope of the novel is to investigate the connection between TWE and OCB in pre-school education with the help of a sophisticated analytical model. Particularly, the research project will attempt to construct the latent dimensions of engagement using SEM and combine the latent variables with the ALR to make valid predictions of the citizenship behavior of teachers. The study also aims at comparing the performance of the proposed model with traditional statistical and machine learning baselines in terms of overall performance measures.

There are three contributions of this study. The first would be the introduction of a new hybrid framework (TWE-SEM-ALR) the combination of latent variable modeling and advanced classification, which improves the possible representation of factors of psychological engagement. Second, it gives empirical data that shows the high predictive capabilities of the proposed approach due to large scale evaluation including confusion matrices, error analysis, receiver operating characteristic (ROC)-area under the curve (AUC) and ablation. Third, the research provides practical implications to the work of educational administrators, as it establishes the engagement dimensions that have a major impact on the organization citizenship behavior and thus, allow implementing the data-driven policies and teacher development strategies. Therefore, the research questions of the study are:

- How do TWE and OCB relate with earlier education on childhood teaching? (RQ1)
- Is SEM a good method of measuring and confirming the latent dimensions of teacher engagement on work such as vigor, dedication and absorption? (RQ2)
- Does TWE-SEM-ALR framework enhance more accurate prediction of OCB in comparison with traditional statistical and machine learning procedures? (RQ3)
- What is the role of combining latent engagement constructs and ALR in improving the classification performance and predictive reliability? (RQ4)

The study is warranted by the fact that, TWE has a considerable impact on behavior on organizational citizenship, which is a necessary factor in enhancing educational quality and the effectiveness of institutions. The conventional approaches will not be able to measure the latent engagement factors and also make correct predictions. Thus, the suggested TWE-SEM-ALR framework is a combination of latent construct modelling and sophisticated classification to enhance higher prediction accuracy and offer credible, data-driven information to the educational management and process on decision making.

This study is innovative in its proposal to combine SEM with ALR to collectively provide both high explanatory and predictive power. This approach, as opposed to prior studies where most of the research relies on SEM or regression, takes as inputs SEM-derived latent engagement constructs as inputs to predictive modelling, which enhances accuracy and preserves theoretical validity. The study, in addition, presents a strong validation grounded on a variety of performance measures, as well as ablation analysis, and the study specifically concentrates on early childhood education (ECE), a context that is underexplored. This combination of latent modelling and prediction is a more thorough and practical way of knowing and predicting the teachers' organization citizenship behavior.

2. LITERATURE REVIEW

This recent stream of work hence conceptually linked leadership, engagement on work, and OCB among teachers, having deep bearings on both psychological and organizational mechanisms explaining discretionary work behavior. As attention started focusing on the underlying mechanisms, research on work with support on organizational began to permeate the models of OCB. For example, Abdulaziz *et al.* [5] established that job engagement and perceived organizational support form an antecedent to teachers' organizational commitment under conditions of work overload and work-life imbalance. In the early years,

Lipscomb *et al.* [6] further show that a source of strong prediction for work engagement teachers includes self-efficacy and professional support, stating that engagement is a critical psychological resource. More modern studies built upon this. Li *et al.* [7] proved that work engagement mediates social connectedness and job control in organizational commitment, while Ertaş and Özdemir [8] proved that organizational commitment mediates the relationship between collective teacher efficacy and work engagement. In particular, Hsieh *et al.* [9] empirically linked perceived organizational support to work engagement and OCB, thus establishing a direct engagement-citizenship pathway. Finally, Kavgacı [10] added to this model that leadership style and trust affect OCB through work engagement, further underlining the integrative nature of these constructs.

In their recent study, Chen *et al.* [11] examined transformational leadership and found that work engagement not only predicts OCB but also moderates the leadership effect, considering engagement a core explaining feature in the model of teacher behavior. Extending this engagement-focusing approach, Romero and Guhao [12] developed a predictive model to explain how development on professional, engagement with teacher, and management practices with human resource jointly uplift OCB within public schools. Citizenship behaviors and engagement have comparatively been investigated in general organizational frameworks. Uran *et al.* [13] documented that work culture influences teacher performance indirectly through both work engagement and OCB, thus providing empirical evidence for dual-mediation models within educational settings. At the individual level, Choong and Ng [14] highlighted self-efficacy and trust in colleagues; here, collective efficacy served to strengthen the relationship between these factors and teachers' OCB. More recent works have illuminated these stances by focusing on relational trust and leadership fairness. Choong *et al.* [15] found that principal trust and teacher self-efficacy significantly predict OCB beyond perceptions of fairness, thus highlighting the relational dynamics at play in schools. Likewise, Tsemach and Barth [16] identified authentic leadership as one of the most important predictors of OCB while controlling for burnout and “quiet quitting.” Authenticity in leadership seems to sustain engagement and voluntary contributions.

Increased dimensions of personality and well-being variables have enriched OCB. According to Todorović and Jovanović [17], personality traits and employment uncertainty shape teachers' citizenship behaviors through well-being pathways. In early childhood and inclusive education contexts, previous studies [18], [19] found that perceived organizational support enhances work engagement through self-efficacy and psychological empowerment, respectively. These, however, indicate a small but growing body of evidence on the engagement-OCB dynamics in ECE. Latifah and Linando [20] found that employee well-being mediates the relationship between psychological empowerment, perceived organizational support, and teachers' OCB, indicating that supportive work environments and empowerment improve teachers' voluntary organizational behaviors. Similarly, Nasution *et al.* [21] demonstrated that organizational justice positively influences both individual- and organization-oriented OCB through job satisfaction, highlighting the significance of fair organizational practices in promoting positive workplace behaviors.

Furthermore, Üztemur *et al.* [22] reported that leadership, teacher autonomy, and organizational trust significantly improve teacher well-being and job satisfaction across different cultural contexts, suggesting that effective leadership and supportive organizational climates are essential for enhancing teacher performance and organizational outcomes. Collectively, these studies confirm that psychological empowerment, organizational support, justice, leadership, and teacher well-being are critical determinants of OCB. However, most existing research relies on conventional mediation or regression-based analyses, with limited attention to integrating latent construct modeling and predictive analytics. This gap motivates the present study, which proposes the TWE-SEM-ALR framework to jointly model teacher work engagement and accurately predict organizational citizenship behavior.

3. RESEARCH DESIGN

3.1. Data source

This study was conducted by use of teacher-centric structured questionnaire to the teachers of ECE. To guarantee content validity and reliability, the survey tool was developed on the basis of well-tested scales obtained in the previous literature. The Utrecht work engagement scale (UWES) was used to measure TWE that included OCB was measured together with the qualities of vigor, devotion, and absorption on a standardized OCB scale that included the aspects of civic virtue, sportsmanship, civility, conscientiousness, and altruism. The demographic variables included in the questionnaire were also age, gender, teaching experience, educational qualification, and type of institution to assist in the control and subgroup analysis.

The survey was carried out online and by paper to ensure that the maximum number of people participated and the survey was accessible. To ensure that items were made clear and according to the time required, a pilot study with a small teacher's sample was done before the actual survey. Every responder was

notified about the study and gave their voluntary participation with anonymity and informed consent according to the ethical standards of research.

The sample was composed of teachers working in ECE institutions that were registered and met the following criteria: i) having worked as a teacher for at least a year to be exposed to the profession sufficiently, and ii) gave voluntary consent to participate in the study. The teaching personnel who served in administrative positions with no teaching duties were locked out to ensure their relevance to the classroom action and performance. The number of teachers attend in the research was 250. The size of this sample is adequate to perform SEM analysis, with sufficient large size of the sample to satisfy the recommended minimum sample size of latent variable modeling, and also to provide credible estimates of the parameters, as well as statistical validity.

Different forms of institutions were being represented and a stratified random sampling approach was applied to make sure that various types of institutions took part in the study, such as the public and private ECE centers. This will enhance the sample diversity and minimizes sampling bias. The structured questionnaire comprised of teacher engagement with work and OCB scales that were validated, and the information was gathered by using the structured questionnaire. The collected information was subsequently preprocessed and normalized and model training and evaluation was done.

3.2. Data preprocessing

Before model development, the questionnaire data obtained were subjected to systematic data preprocessing process to ensure accuracy, consistency and appropriateness to SEM and ALR. To begin with, the raw answers were filtered out by the incomplete response forms and the cases with a high number of missing values were filtered out. The mean substitution technique was used in case the number of missing data was small, since it is suggested to use this technique in the case of Likert-scale surveys. The items that were negatively worded were reverse coded to ensure that the direction of the items conformed. Data were cleaned and analyzed using SEM and ALR to predict OCB.

3.3. TWE-SEM-ALR

The TWE-SEM-ALR framework is an integrated SEM and ALR that will be used to control and forecast OCB among early childhood teachers. The first approach is to model TWE as a latent construct that is measured by various observed indicators, which are energy, commitment, and absorption, and test the causal effect of TWE on OCB with measurement error control. This step is aimed at theory validation and explanatory power.

3.3.1. TWE-SEM

SEM is a multivariate analysis method that is based on factor analysis and path analysis that facilitate the study of the complex connections between the observable indicators of latent variables. SEM can be especially applicable in educational and psychological studies since most of the fundamental variables, including the engagement on work of teachers and OCB, are impossible to measure: OCB and many of the items on questionnaires can be explained in terms of it. SEM enables the researcher to test the measurement validity of these constructs at the same time investigating the causal associations between them in one single framework. The measurement model of the exogenous latent variable TWE can be mathematically given in (1):

$$X = \Lambda_x \xi + \delta \quad (1)$$

In which X is the observed measures of engagement on work, ξ is a latent variable TWE and Λ_x is the matrix of factor loadings, which expresses the magnitude of the rapport of individual indicators to the latent construct, and δ is measurement error. In the same way, the endogenous latent variable OCB was measured using (2), in which Λ_y signifies observed measures of OCB (altruism and conscientiousness), η signifies the latent OCB measure, Λ_y represents the factor loading matrix, and ε represents measurement error. The structural model that implies a test of the hypothesized relationship between latent variables is formulated in (3):

$$y = \Lambda_y \eta + \varepsilon \quad (2)$$

$$\eta = \Gamma \xi + \zeta \quad (3)$$

The formula used in this research scenario suggests that the OCB η is affected by TWE ξ though Γ is the coefficient on path that shows the scale and direction of the effect, and ζ is the structural error. The statistically significant and positive Γ value indicates that the more TWE is high, the higher the OCB. Collectively, the three equations reflect the way that SEM can confirm both measurement constructs and also test a theoretical relationship which presents a firm and understandable model that can be used to explain teacher behavior in ECE.

3.3.2. ALR

An artificial intelligence (AI)-based business performance evaluation uses LR to assess the economic, social, and environmental performance of new power systems. LR is a well-liked and effective classification technique that finds a linear combination of inputs and uses a sigmoid function to convert it into a probability between 0 and 1, describing the likelihood of a particular result. Using sigmoid as a base creates linear models that are useful for both probability estimates and classification. Sigmoid function: described about the function of sigmoid in (4), where z is the combination of linear features.

$$f(z) = \frac{1}{1+f^{-z}} \quad (4)$$

Calculation on conditional probability: this equation explains the conditional probability computation below to evaluate the performance sustainability, as shown in (5). $Z = 1$ indicates strong sustainability performance, $Z = 0$ indicates low sustainability performance, and x is a feature vector that shows environmental, social, and economic variables. e : the weight vector; a : the bias term.

$$\begin{aligned} o(Z = 1|e) &= \frac{\exp(x.e+a)}{1+\exp(x.e+a)} \\ o(Z = 0|e) &= \frac{1}{1+\exp(x.e+a)} \end{aligned} \quad (5)$$

Training set: inputs to assess businesses in (6), where the j^{th} firm's sustainability features are displayed. There is a representation of the sustainability classification (0=low, 1=high), m : the number of training firms. e_j is the firm j 's feature vector. Likelihood function: $e_j \in Q, e_j \in \{0,1\}$, in (7).

$$C = \{(e_1, z_1), (e_2, z_2), \dots, (e_m, z_m)\} \quad (6)$$

$$\prod_{j=1}^m [\psi(e_j)]^{z_j} [1 - \psi(e_j)]^{1-z_j} \quad (7)$$

Function on log-likelihood: as mentioned logarithmic expression in (8), where there is a possibility of achieving good sustainability performance by $\pi(e_j)$. Outcome on final model: the model that is utilized to evaluate sustainability performance in (9) is the one that follows, where the optimized feature vector from SSFLA is represented by $\hat{x}$. This model offers an approach systematic to assessing the sustainability performance of companies in new type power systems by looking at their environmental, economic, and social performance parameters.

$$K(x) = \log \left\{ \prod_{j=1}^m [\psi(e_j)]^{z_j} [1 - \psi(e_j)]^{1-z_j} \right\}, = \sum_{j=1}^m [z_j \log \pi(e_j) + (1 - z_j) \log(1 - \pi(e_j))] \quad (8)$$

$$o(Z = 1|e) = \frac{\exp(\hat{x}.w+a)}{1+\exp(\hat{x}.w+a)}, \quad o(Z = 0|e) = \frac{1}{1+\exp(\hat{x}.w+a)} \quad (9)$$

Figure 1 shows a clear and systematic flow of the proposed TWE-SEM-ALR model of TWE analysis and prediction of OCB. The first stage involves the teacher-centric questionnaire dataset that will be used to record demographic data and the responses related to the engagement and OCB. These raw data are next subjected to a data preprocessing phase where cleaning and normalization are done to determine the consistency and quality of the data. This applies the measurement model based on SEM to test constructs and remove latent dimensions of engagement. The resulting latent engagement scores, which are vigor, dedication, and absorption, are meaningful inputs to the ALR module, which is used to conduct the OCB prediction. Lastly, performance analysis, accuracy and other measures, is performed at the end of the workflow, and a comparative and ablation analysis are carried out to determine the efficiency of the suggested model in comparison to the baseline methods. All in all, the diagram visually highlights the coherent flow, modularity, and incorporation of the explanatory and predictive aspects within the study.

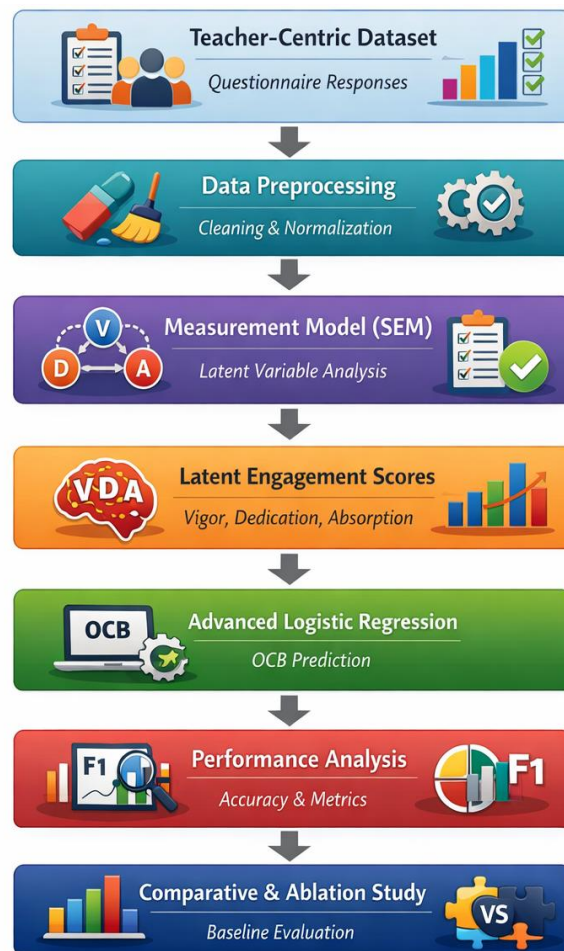


Figure 1. Workflow of the proposed method

4. RESEARCH FINDINGS AND ANALYSIS

4.1. Experimental setup

The study design would be used to test the validity of the suggested TWE-SEM-ALR model to examine how TWE and OCB are related to each other. Data on teacher-centric questionnaires were gathered with validated Likert-based instruments on engagement and citizenship dimensions on early childhood educators. Data cleaning and normalization were followed by splitting the data into trained and tested set with an 80:20 proportion. The first time SEM was used in estimating the latent engagement constructs and testing the measurement model. Prediction of the level of OCB was done using the resulting latent scores as inputs to the ALR classifier. Accuracy, precision, recall, F1-score, AUC, confusion-matrices, and error measures were used to assess performance, and the outcomes were contrasted with the baseline models such as the traditional logistic regression and machine learning classifiers as a way of ensuring a fair and thorough evaluation.

4.2. Performance metrics

To determine the efficiency of the proposed TWE-SEM-ALR model, the model performance on model was compared to various baseline models that are usually applied in the research regarding educational and organizational behavior. The choice of these baselines is to reflect the traditional statistical approaches, theory-based models, and simple machine learned classifiers. Both the explanatory power measures (in the case of SEM-based models) and predictive performance measures (in the case of classification-based models) were used to compare the performance. In testing the predictive performance of Table 1, the accuracy, precision, F1-score, recall, and AUC were evaluated to classify the classification-based models. The suggested TWE-SEM-ALR model was always higher than the base classifiers. Although the traditional binary logistic regression (BLR) and decision tree (DT) models demonstrated a moderate predictive accuracy, they were constrained by the sensitivity to noise and lack of latent variables refinement.

Conversely, the proposed model used the latent engagement scores derived by SEM and produced better classification stability and discrimination capability as indicated by a higher AUC value and a better F1-score. These findings suggest that educators who had a bigger latent engagement score were better categorized into high-OCB groups via the suggested method.

Table 1. Performance comparison of baseline models and the proposed TWE-SEM-ALR

Model	Accuracy (%)	Precision	Recall	F1-Score	AUC
Multiple linear regression (threshold)	71.8	0.70	0.69	0.69	0.74
BLR	78.6	0.77	0.75	0.76	0.82
DT	81.4	0.80	0.78	0.79	0.85
Random forest (RF)	84.9	0.84	0.83	0.83	0.89
Standalone SEM (latent score classification)	82.3	0.81	0.80	0.80	0.86
Proposed TWE-SEM-ALR	88.7	0.88	0.86	0.87	0.93

4.3. Descriptive statistics

The basic characteristics of the data of the teacher questionnaire were therefore summarized and understood through descriptive statistics then advanced modeling was carried out. The important measures like calculations were made for the mean, standard deviation, minimum, maximum, skewness, and kurtosis on the main constructs of TWE, OCB, and corresponding sub-dimensions. The outcomes demonstrate a moderate to high average rate of engagement and citizenship among earlier educators on childhood and the standard deviation values reflect an acceptable variability among the respondents. The skewness and kurtosis values are within the suggested range, which proves that the information is approximately normal and fit to run further SEM and ALR analysis. On the whole, descriptive statistics give the background information about the dataset and justify the reliability and validity of the further inferential analysis.

Table 2 reveals that the demography of the study is primarily composed of female early childhood educators with most of the people being female representing gender balance that is usually experienced in the field. The respondent's majority is aged among 30 and 39 years and has an experience of 5-10 years of experience on teaching thus a sample of a significant professional exposure. The percentage of teachers with a bachelor's degree is high and the inclusion of both the private and the public institutions brings about diversity in the organization. In general, the demographic balance indicates that the sample is balanced and apt to investigate the work engagement on teacher and OCB.

Table 2. Respondents' demographic profile

Variable on demographic	Category	Frequency(n)	Percentage (%)
Gender	Male	58	23.2
	Female	192	76.8
Age (years)	Below 30	64	25.6
	30-39	98	39.2
	40-49	62	24.8
	50 and above	26	10.4
Teaching experience	<5 years	72	28.8
	5-10 years	96	38.4
	11-15 years	54	21.6
	>15 years	28	11.2
Educational qualification	Diploma	48	19.2
	Bachelor's degree	142	56.8
	Master's degree	60	24.0
Type of institution	Public	136	54.4
	Private	114	45.6

Table 3 shows the descriptive statistics of TWE and the OCB dimensions. Mean scores show moderate to high results in engagement and citizenship behavior of teachers with the highest average scores of dedications and conscientiousness. The values of standard deviation indicate that there is acceptable variability among respondents implying that there was similarity in perceptions. Moreover, the skewness and the kurtosis value are within the reasonable range, which proves that there is approximate normality of the data. These findings support the appropriateness of the data to be used in further SEM and ALR analysis.

Table 4 of the model assessment on the measurement was done to test the validity and reliability of the latent constructs to represent TWE and OCB before testing the structural relationships. The reliability was tested through the Cronbach alpha and composite reliability (CR) with all constructs having a value of above

the recommended value of 0.70 as high levels indication of internal consistency on internal. The convergent validity was measured with standardized factor loading and average variance extracted (AVE), in which, loading factor was more than 0.60 as well as the AVE more than 0.50 and the observed indicators were sufficient to represent the respective latent constructs. The Fornell-Larcker criterion was utilized in verifying validity on discriminant whereby the square root of AVE of every construct was expected to be higher than the correlation of the construct with the rest. On the whole, measurement model showed good psychometric characteristics, which justify the appropriateness of constructs to be further evaluated with the help of structural model with TWE-SEM with ALR.

Table 3. Descriptive statistics of TWE and OCB dimensions

Construct	Dimension	Mean	Std. deviation	Skewness	Kurtosis
TWE	Vigor	3.98	0.61	-0.42	-0.31
	Dedication	4.12	0.58	-0.47	-0.28
	Absorption	3.89	0.64	-0.36	-0.34
OCB	Altruism	4.05	0.57	-0.45	-0.26
	Conscientiousness	4.18	0.55	-0.52	-0.22
	Sportsmanship	3.92	0.63	-0.38	-0.30
	Civic Virtue	4.10	0.56	-0.49	-0.24

Note: All items were measured using a 5-point Likert scale (1=strongly disagree, 5=strongly agree). Skewness and kurtosis values are within acceptable limits (± 2), indicating approximate normality.

Table 4. Measurement model assessment

Construct	Indicator	Loading	CR	AVE
TWE	Vigor	0.81	0.89	0.68
	Dedication	0.85		
	Absorption	0.78		
OCB	Altruism	0.83	0.91	0.66
	Conscientiousness	0.80		

4.4. Confusion matrices

The performance of the proposed method classifying data was evaluated with the confusion matrices which allow determining the correctness of the predicted outcomes on Table 5 relation to the real class labels (high OCB vs. low OCB). The matrix gives the results in the form of true positives (TP), true negatives (TN), false positives (FP), and false negatives (FN), which gives a clear understanding of the right and wrong prediction. The confusion matrix is used to calculate the vital performance indicators like accuracy, precision, recall, F1-score and AUC, and it proves that the proposed model has a balanced and stable classification as well as the baseline approaches.

Table 5. Confusion matrix for TWE-SEM-ALR

Actual/predicted	High OCB	Low OCB
High OCB	96 (TP)	8 (FN)
Low OCB	10 (FP)	86 (TN)

4.5 Ablation Study

The study will give a clear indication of the impact of each of the modules on predictive performance overall by removing or disabling specific elements, leaving the rest of the structure intact. This will assist in justifying the design of the model and make sure that the benefits in performance are not accidental. The removal of the SEM component leads to significantly worse performance, suggesting that the latency variables (vigor, dedication, and absorption) must be modeled in order to describe the latent terrain of teacher engagement. Likewise, the omission of the ALR component results in a decrease of classification accuracy and AUC, which proves that ALR improves decision boundaries compared to a regular regression because it is more effective in addressing non-linear relationships and separability of classes. Figure 2 of the ablation accuracy curve indicates the definite and steady increase of the performance with the addition of the major elements of the TWE-SEM-ALR model. The least accurate model is the baseline logistic regression model and addition of engagement factors, ALR and SEM increases performance steadily. The complete TWE-SEM-ALR model has the greatest accuracy and it shows the synergistic and complementary role of all elements in successful prediction of teacher OCBs.

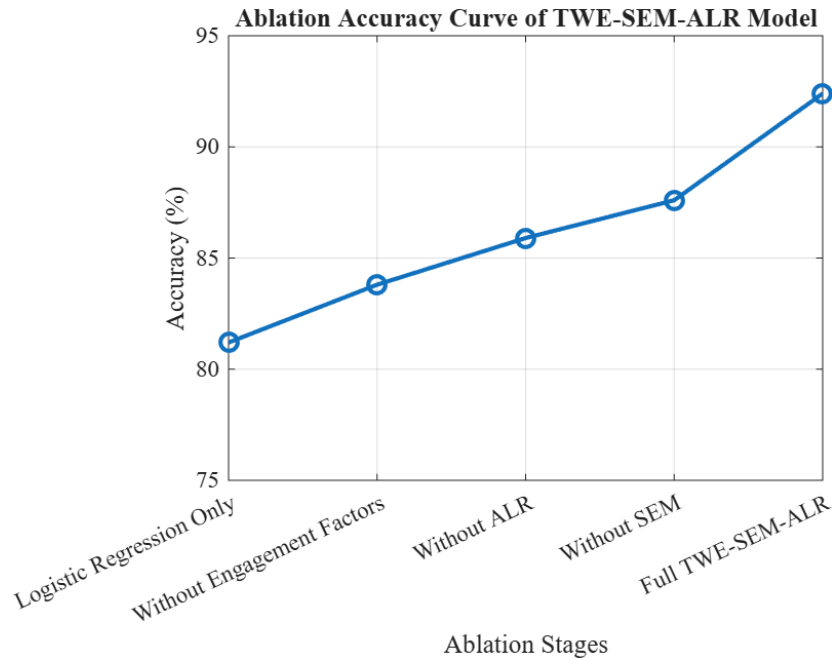


Figure 2. Ablation accuracy curve of proposed method

5. DISCUSSION

This study's results indicate that ECE teachers' work engagement has a significant effect on OCB. There is a positive relationship between teachers' vigor, dedication, and absorption and their voluntary and supportive organizational behaviors. The results support transformational leadership and social exchange theories, which state that a positive organizational climate will inspire staff to respond in kind with positive behaviors in the workplace. In line with this, Chen *et al.* [11] also found that work engagement is a psychological factor which significantly influences OCB when the transformational leadership is applied.

The results further represent that teacher engagement acts as a crucial mediating mechanism in promoting OCB. The SEM analysis showed that engagement-related significantly contributes on latent variables to the prediction of behavior, and the ALR classifier can effectively enhance the prediction accuracy. This result is consistent with the result from Romero and Guhao [12], who created a predictive model indicating that teacher engagement and teacher professional development had a strong effect on OCB in public schools. Similarly, the relationship between work culture and teacher performance was mediated by OCB and work engagement as a factor found by Uran *et al.* [13]. These researches add to the significance of engagement as a core element in positive organizational behavior.

In the present study, it is also emphasized that self-efficacy and interpersonal trust are important to enhance teachers' organizational behavior. Self-efficacy and trust in colleagues had significant positive effects on OCB, and that collective efficacy would moderate the relationship between self-efficacy and trust in colleagues and OCB [14]. Likewise, Choong *et al.* [15] discovered that teachers' self-efficacy and principals' trust contribute positively to teachers' OCB. The findings also corroborate the current results with a focus on the positive correlation between teachers feeling confident in their skills and the extent to which they engage in discretionary and cooperative behaviors, as well as the positive correlation between having colleagues and administrators who support their abilities and discretionary and cooperative behaviors.

Leadership and organizational support were also identified as important factors in the engagement and OCB. The results support those of Tsemach and Barth [16], who found that authentic leadership was positively correlated with OCB and negatively correlated with teacher burnout and disengagement behavior. Otherwise, through a systematic review, Ahmed [23] found that transformational and supportive leadership styles are significant factors affecting OCB of teachers. From this information, it is clear that institutional leadership is a fundamental key in creating supportive environments that would boost teachers' motivation and engagement.

Furthermore, the study has confirmed that the organizational and psychological conditions have a significant effect on the teachers' engagement and citizenship behavior. In addition, Jiao *et al.* [18] found that teacher self-efficacy is a mediating factor between organizational support and work engagement, while in another study, Li and Hashim [19] reported that psychological empowerment also plays a mediating role

between organizational support and work engagement in preschool teachers. Likewise, Üztemur *et al.* [22] showed that organizational justice indirectly relates to OCB via job satisfaction and organizational commitment. All of these studies agree with the present results that organizational fairness, empowerment, and support are critical components in maintaining positive teacher behaviors.

The present results also support research that focuses on organizational climate, professional commitment, and well-being. Latifah and Linando [20] found that teacher autonomy and organizational trust are positively related to OCB, especially for high levels of teacher professional commitment. Todorović and Jovanović [17] also showed that personality traits, well-being and employment insecurity have a significant impact on teachers' OCB. Elyashiv and Rozenberg [24] also stated that teacher education promotes teachers' self-efficacy and professional commitment, which in turn leads to greater engagement and professional competence. Organizational identification is a significant predictor of teachers' organizational citizenship behavior, supporting social identity theory and demonstrating that stronger identification with the school increases voluntary organizational contributions [25].

The present research adds to the body of previous literature by combining the latent construct modelling with predictive analytics using the proposed TWE-SEM-ALR framework. Previous research focused mainly on conceptual reviews, regression analysis, and SEM in order to explain the relationships among the behaviors. On the contrary, this study integrates the latent engagement constructs derived from the SEM with ALR, and both theoretical interpretation and high predictive accuracy are gained. The framework is further strengthened by the use of ablation analysis, the confusion matrix analysis, the ROC-AUC analysis and the error analysis in terms of robustness and practical applicability.

In conclusion, the results support that TWE is a strong predictor of OCB. The framework proposed offers a bridge between explanatory psychological modelling and advanced predictive techniques, which benefits the field of education research. From a perspective on practical, the findings indicate that school leaders and teachers need to enhance teacher engagement, organizational support, professional development and leadership skills to enhance organizational effectiveness and create positive learning environments.

The results indicate that the work engagement of teachers is an important predictor of the OCB, and the suggested TWE-SEM-ALR framework offers a valid and correct way of studying the impact. The practical value of this to the educational institutions is that through such models, the administrators will be able to know the level of engagement, motivate teachers better, and increase the overall effectiveness of the organization, based on the data-driven decision-making.

Subsequently, this framework can be expanded with bigger and longitudinal datasets to track engagement patterns over time in the future. Addressing the latest methods to enhance the effectiveness of prediction, including methods of deep learning, real-time data acquisition, intelligent decision support systems, and so forth, will also contribute to the effectiveness of the prediction and the creation of adaptable educational management and teacher engagement monitoring systems.

6. CONCLUSION

The model of TWE-SEM-ALR is effective in tracking latent constructs of engagement and has high performance results in comparison with the baseline techniques in various metrics of evaluation. These results support the significance of the theoreticalization of the aspects of psychological engagement when examining teacher behavior in educational establishments. To make the framework more applicable to future work, possible extensions of the framework include using longitudinal data to examine the dynamics of engagement over time and integrating deep learning or ensemble classifiers to enhance the accuracy of prediction further. The use of qualitative data, e.g., the interviews or classroom observations, might be used as well to gain an understanding on better mechanism between engagement and citizenship behavior. Future studies should consider more diverse datasets, longitudinal data, and additional psychological or organizational factors to enhance model generalizability and robustness. This study has several limitations found when interpreting the results, the model performance may be sensitive to hyperparameter settings and data preprocessing steps, which require careful tuning. Finally, environmental variability, noise, and dynamic real-world conditions were not fully considered, which may affect robustness in practical implementations.

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This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

Exploring the relationship between teacher work engagement and organizational ... (Yixuan Zhao)

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C : Conceptualization

M : Methodology

So : Software

Va : Validation

Fo : Formal analysis

I : Investigation

R : Resources

D : Data Curation

O : Writing - Original Draft

E : Writing - Review & Editing

Vi : Visualization

Su : Supervision

P : Project administration

Fu : Funding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

The data used to support the findings of this study are available from the corresponding author, [CS], upon request.

REFERENCES

- [1] A. H. Gnanarajan, N. Kengatharan, and T. Velnampy, "Exploring the prevalence of teachers' organizational citizenship behaviour and its determinants: Evidence from an under-researched cultural milieu," *Qualitative Research in Education*, vol. 9, no. 1, pp. 95–123, Feb. 2020, doi: 10.17583/qre.2020.4531.
- [2] B. S. Nugroho *et al.*, "Effect of organizational citizenship behavior, work satisfaction and organizational commitment toward Indonesian school performance," *Systematic Reviews in Pharmacy*, vol. 11, no. 9, pp. 962–971, 2020, doi: 10.31838/srp.2020.9.140.
- [3] P. Khandelwal and M. Nair, "Is Organizational Citizenship Behaviour of Teachers Related to the Effectiveness of Higher Education Institutions?" *MIER Journal of Educational Studies Trends and Practices*, vol. 12, no. 1, pp. 52–71, May 2022, doi: 10.52634/mier/2022/v12/i1/2182.
- [4] T. B. Emirie and M. M. Gebremeskel, "How do primary school teachers practice organisational citizenship behaviour in Amhara regional state, Ethiopia? The case of Bahir Dar city," *Education 3-13*, vol. 52, no. 8, pp. 1398–1412, Nov. 2024, doi: 10.1080/03004279.2022.2150064.
- [5] A. Abdulaziz, M. Bashir, and A. A. Alfalih, "The impact of work-life balance and work overload on teacher's organizational commitment: do Job Engagement and Perceived Organizational support matter," *Education and Information Technologies*, vol. 27, no. 1, pp. 9641–9663, Aug. 2022, doi: 10.1007/s10639-022-11013-8.
- [6] S. T. Lipscomb, K. D. Chandler, C. Abshire, J. Jaramillo, and B. Kothari, "Early Childhood Teachers' Self-efficacy and Professional Support Predict Work Engagement," *Early Childhood Education Journal*, vol. 50, no. 4, pp. 675–685, Apr. 2022, doi: 10.1007/s10643-021-01182-5.
- [7] X. Li, Y. Xu, and D. Huang, "Exploring the interplay between social connectedness, job control, and organizational commitment: the mediating role of work engagement among Chinese teachers," *BMC Psychology*, vol. 13, no. 1, p. 31, Jan. 2025, doi: 10.1186/s40359-025-02355-2.
- [8] B. D. Ertaş and M. Özdemir, "The mediation of organizational commitment between collective teacher efficacy and work engagement," *Social Psychology of Education*, vol. 27, no. 5, pp. 2677–2700, Oct. 2024, doi: 10.1007/s11218-024-09949-5.
- [9] C. C. Hsieh, W. C. Chien, H. C. Yen, and H. C. Li, "Same same' but different? Exploring the impact of perceived organizational support at the school and teacher levels on teachers' job engagement and organizational citizenship behavior," *Frontiers in Psychology*, vol. 13, Dec. 2022, doi: 10.3389/fpsyg.2022.1067054.
- [10] H. Kavgaci, "Exploring the relationship among paternalistic leadership, teacher trust in principal, work engagement, and organizational citizenship behavior: A moderated mediation model," *Journal of Pedagogical Research*, vol. 7, no. 1, pp. 273–289, Mar. 2023, doi: 10.3390/JPR.2023.19638.
- [11] C. C. Chen, T. Y. Liu, and H. C. Chen, "Relationship between transformational leadership, work engagement, and organisational citizenship behaviour: the moderating effect of work engagement," *Educational Studies*, vol. 51, no. 5, pp. 915–934, Sep. 2025, doi: 10.1080/03055698.2024.2369899.
- [12] O. S. Romero and E. S. Guhao Jr., "The influence of personal professional development, teacher engagement, and human resource management practices on organizational citizenship behavior in public schools: A prediction model," *International Journal of Advance Research and Innovative Ideas in Education*, vol. 10, no. 4, pp. 186–205, 2024.
- [13] A. V. N. Uran, D. Subiyanto, and S. Hadi, "The Effect of Work Culture on Teacher Performance Through Citizen Organizational Behavior and Work Engagement as Mediating Variables," *Dinasti International Journal of Economics, Finance & Accounting*, vol. 5, no. 3, pp. 1689–1699, 2024, doi: 10.38035/dijefa.v5i3.3034.
- [14] Y. O. Choong and L. P. Ng, "Shaping teachers' organizational citizenship behavior through self-efficacy and trust in colleagues: moderating role of collective efficacy," *BMC Psychology*, vol. 12, no. 1, p. 532, Oct. 2024, doi: 10.1186/s40359-024-02050-8.
- [15] Y. O. Choong, L. P. Ng, and T. C. Lau, "Beyond fairness: exploring organizational citizenship behavior through the lens of self-efficacy and trust in principals," *Humanities and Social Sciences Communications*, vol. 12, no. 1, p. 288, Mar. 2025, doi: 10.1057/s41599-025-04611-7.
- [16] S. Tsemach and A. Barth, "Authentic leadership as a predictor of organizational citizenship behaviour and teachers' burnout: What's 'quiet quitting' got to do with it?" *Educational Management Administration and Leadership*, vol. 53, no. 5, pp. 1105–1125, Sep. 2025, doi: 10.1177/17411432231212288.

- [17] D. Todorović and D. Jovanović, "Teacher's organizational citizenship behavior in the context of personality traits, well-being and employment uncertainty," *Work*, vol. 80, no. 4, pp. 1769–1781, Nov. 2025, doi: 10.1177/10519815241298102.
- [18] C. Jiao, J. Qian, and H. Liu, "The Relationship Between Preschool Inclusive Education Teachers' Organizational Support and Work Engagement: The Mediating Role of Teacher Self-Efficacy," *Frontiers in Psychology*, vol. 13, May 2022, doi: 10.3389/fpsyg.2022.900835.
- [19] W. Li and S. Bin Hashim, "How perceived organizational support affects preschool teachers' engagement: Examining mediating effect of psychological empowerment," *Multidisciplinary Science Journal*, vol. 8, no. 1, p. 2026017, Jul. 2025, doi: 10.31893/multiscience.2026017.
- [20] I. N. Latifah and J. A. Linando, "Role of employee well-being mediating psychological empowerment and perceived organizational support on teacher organizational citizenship behavior," *Edu Cendikia: Jurnal Ilmiah Kependidikan*, vol. 6, no. 1, pp. 739–748, Apr. 2026, doi: 10.47709/educendikia.v6i01.8253.
- [21] M. F. P. Nasution, Zaitul, and Listiana, "Organizational justice and citizenship behaviors: the mediating role of job satisfaction across OCBI and OCBO," *Journal of Educational Management Research*, vol. 5, no. 2, pp. 2377–2394, Feb. 2026, doi: 10.61987/jemr.v5i2.1994.
- [22] S. Üztemur, A. Gökalp, A. İlğan, and E. Dinç, "Leadership, autonomy, and organizational trust as predictors of teacher wellbeing and job satisfaction: a cross-cultural study based on PISA 2022 data," *Frontiers in Psychology*, vol. 16, p. 1703458, Jan. 2026, doi: 10.3389/fpsyg.2025.1703458.
- [23] E. I. Ahmed, "Principals' leadership styles and teachers' organizational citizenship behaviour: a systematic review of research," *International Journal of Educational Management*, vol. 39, no. 1, pp. 219–239, Jan. 2025, doi: 10.1108/IJEM-08-2024-0508.
- [24] R. A. Elyashiv and K. Rozenberg, "Fostering early career teachers' preparedness, self-efficacy and professional commitment: The role of teacher education," *Teaching and Teacher Education*, vol. 148, p. 104691, Oct. 2024, doi: 10.1016/j.tate.2024.104691.
- [25] H. Öz and E. Meriç, "The predictive power of organizational identification on teachers' organizational citizenship behaviors," *Frontiers in Psychology*, vol. 17, 2026, doi: 10.3389/fpsyg.2026.1818062.

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