Research Square

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Technical Support Perceived Usefulness and Ethical Awareness in Generative AI Implementation through Language Teacher Attitudes

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Abstract

The integration of generative artificial intelligence (GenAI) into language education has recently changed the narrative of the conventional pedagogical practice. This study examines the direct effects of technical support, perceived usefulness, and ethical awareness on GenAI implementation in language education and investigates the mediating role of teachers' attitudes in these relationships. The study uses a cross-sectional design and collected data from 364 participants from secondary school language teachers in Nigeria. The survey data is quantitative in nature and is analysed using Structural Equation Modeling (SEM). The results showed that technical support (β = 0.128), perceived usefulness (β = 0.092), and ethical awareness (β = 0.164) had significant positive direct effects on GenAI implementation, while teachers' attitudes had a stronger direct effect on GenAI implementation (β = 0.574). In addition, teachers' attitudes significantly mediated the relationships between technical support (β = 0.112), perceived usefulness (β = 0.160), ethical awareness (β = 0.133), and GenAI implementation. The study builds on the Unified Theory of Acceptance and Use of Technology (UTAUT) as the theoretical framework. The implications of these findings are important for educational institutions where GenAI is used in the context of language education. Practical implications point to better training and ethical frameworks to enhance competence in the use of AI-enabled language education. This study offers new insights into how technology is used in education and how it affects ethics, which has not been adequately addressed in the previous studies.

INTRODUCTION

The integration of generative artificial intelligence (GenAI) into education has changed previous pedagogical models in recent years, particularly in language education, with a large number of higher education institutions worldwide integrating AI technology (Antoninis et al., 2023). However, this rapid technological shift has been accompanied by significant challenges, with a number of language teachers considering it as a challenge to integrate GenAI tools into their teaching and learning processes (Moorhouse & Kohnke, 2024). The extent of the challenges in GenAI implementation was also emphasised by some worrying figures showing that "only 28% of teachers indicated their willingness to use GenAI tools" ethically and pedagogically (Kohnke et al., 2023; Sajid Farooq et al., 2025).

Thus, the critical issue arose from several integrated factors surrounding the use of GenAI in language education. A number of studies showed that a significant number of higher education institutions did not have adequate technical support (TS) and 67% of language teachers had ethical questions about "the use of GenAI in language teaching" (Hoernig et al., 2024). It was also found that while 82% of teachers recognised that GenAI could be useful in their profession, only 34% actually used these tools in the classroom. This resulted in a significant discrepancy between recognition and implementation, which was also supported by the findings that 71% of teachers indicated low self-efficacy in evaluating GenAI for their ethical implications and 65% attributed inadequate TS as a major problem (Alshraah et al., 2024).

While research on the GenAI implementation in language education is growing, a significant gap remains in understanding the factors that collectively influence teachers' use of GenAI in this context. Technical and infrastructural support, perceived usefulness, and ethics have been examined previously (such as: Chibidi & Magwa, 2026; Farran et al., 2026; Haruna et al., 2025), these studies are typically either in isolation or within models that focus primarily on technological utility or infrastructural conditions. This fragmented approach is particularly limiting in the case of GenAI, whose effective implementation depends not only on adequate technical support but also on teachers' awareness of AI's pedagogical potential and the ethical implications of its use. These factors, however, can be analysed within a single model, offering a more holistic understanding of the conditions and perceptions that shape the implementation of GenAI in language education.

Another gap concerns how these factors affect implementation. Technical support and perceived usefulness are not necessarily directly linked to classroom implementation, as teachers interpret the conditions and benefits of technology in relation to their attitudes towards it. Likewise, ethical awareness can influence implementation through teachers' attitudinal judgements about the use of GenAI in the classroom context and in L2 teaching. However, there has been little empirical research to date on whether teachers' attitudes serve as an intervening variable between these technological, evaluative, and ethical factors and the implementation of GenAI. Hence, the extended UTAUT model, which adds technical support, perceived usefulness, and ethical awareness as antecedents and teachers' attitudes as mediators, can explain GenAI implementation in the field of language education more comprehensively.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Technical Support and Generative AI Implementation

The role of TS in the implementation of technology in education became has gained prominence in the recent studies. Studies showed that TS programs have a major impact on teachers' self-efficacy in the use of new technologies (Subramaniam et al., 2024). Research has shown that institutions with a well-developed TS infrastructure have 45% higher chances of effective AI Implementation than their counterparts with weak support structures (Moorhouse & Kohnke, 2024). This implies that, to integrate technology into pedagogy, TS must match the needs of teaching.

On the other hand, the enhancement of generative AI in education revolutionalised teaching-learning process. Recent research studies provided evidence of the successful implementation of GenAI, including the incorporation of AI tools into the curriculum, assessment, and teaching and learning activities (Chere & Wayi-Mgwebi, 2024). In their study, Koroleva and Jogezai (2024) and Aldrees et al., (2024) pointed out that best GenAI practices require a set schedule for proactive planning and constant assessment of learners' needs, while having the flexibility to adapt the approaches used. Research also found that the effectiveness of AI implementation requires that teachers know how to use AI features and that several instructional principles and ethical issues must be considered (Alqahtani & Wafula,

2024). Thus, the complexity of implementing GenAI required knowledge in both technological and instructional approaches. For example, Mohamed (2024) noted that the effectiveness of GenAI implementation is related to teacher training, infrastructure, policy and standards.

With this in mind, research studies that sought to examine the relationship between TS and technology integration in the classroom reported positive results. According to Stewart (2023), institutions that have adequate TS to implement the systems have high success rates at 42%. In their research, Molefi et al. (2024) found that proactive TS increased teacher self-efficacy by 28%. Further studies by Yang et al. (2024) also supported this assertion that TS improved the teachers' capacity to adopt AI technologies optimally. Based on these findings, the following research hypothesis was presented:

H1: Technical support positively influences GenAI implementation in language education.

Perceived Usefulness and GenAI Implementation

Past studies have demonstrated that PU is one of the most important factors influencing the adoption of technology in educational institutions. Research has also shown that teachers' perceptions of the value of technology determine their ability to use technology-related tools in the classroom (Moorhouse & Kohnke, 2024). Consequently, the study on PU significantly related to technology use and improved learning outcomes (Sugandini et al., 2018). In this regard, prior experience, institutional support, and professional development had a mediating effect between PU and actual GenAI implementation success.

Hence, research on PU and GenAI showed positive correlations. Ma et al. (2024) and Alzakari et al., (2024) found that PU increased the adoption of artificial intelligence tools by 56%. A study conducted by Celik (2023) found that teachers who understood the benefits of AI had a 48% higher chance of using it successfully. In another study by Ali et al. (2024), for example, found that a positive perceived usefulness of AI led to 40% higher efforts towards integration. Further studies by found that higher PU significantly predicted the successful GenAI implementation in pedagogical settings. Based on these findings, the following research hypothesis was presented:

H2: Perceived usefulness positively influences GenAI implementation in language education.

Ethical Awareness and GenAI Implementation

Ethical awareness as it relates with technology integration is an important factor. Research has shown that teachers' EA plays an important role in the adoption of technology and implementation strategies (Atalla et al. 2024). For example, increased EA has been found to enhance purposeful and reflective technology integration and approaches to managing student information and AI-generated content in particular (Le-Nguyen and Tran, 2024). Elements of EA included decisions related to fairness, transparency, accountability and social relevance. van Stekelenburg (2024) showed how a strong EA provides teachers with better opportunities to make decisions about the use of technology in the

classroom without jeopardizing pedagogical integrity. The studies also call for the need for appropriate institutional arrangements that promote ethical approaches to technology implementation.

In the light of the above, studies on EA of GenAI implementation provided crucial relationship. Alahmed et al (2023) found in their study that an improved EA of practice increased the quality of GenAI implementation significantly. Recently study by Oladoyinbo et al. (2024) also found that EA increased AI integration performance. Subsequent studies by Atalla et al. (2024) and Rane et al. (2024) also supported the view of a positive correlation. In line of above, the following research hypothesis was presented:

H3: Ethical awareness positively influences GenAI implementation in language education.

Technical Support and Language Teacher Attitudes

Studies examining the effect of TS on teachers' attitudes revealed positive correlations. Li et al. (2019) established that effective TS enhanced teacher attitudes by 44%. Hung and Jeng (2013) found that TS quality accounted for 47% of the variance in teachers' attitudes. Saloviita, (2020) confirmed the existence of significant positive links between support adequacy and the teacher's positive attitude. Other studies carried out by Bell-O'Leary (2014) and Saloviita (2020) affirmed similar findings of a positive correlation between TS and teachers' attitudes. Based on these findings, the following hypothesis was formulated:

H4: Technical support positively influences language teacher attitudes toward generative AI.

Perceived Usefulness and Language Teacher Attitudes

The synthesis of various studies evaluating PU influence on teacher attitudes showed substantial relationships. According to Moses et al. (2013), PU increased teacher attitudes by 51%. Sugandini et al. (2018) confirmed that PU accounted for 43% of teachers' attitudes. Other studies by Moses (2013) showed positive relationships between PU and teacher attitudes. Based on these findings, the following research hypothesis was formulated:

H5: Perceived usefulness positively influences language teacher attitudes toward GenAI implementation.

Ethical Awareness and Language Teacher Attitudes

Research comparing the influence of EA on the teacher attitudes produced significant findings. According to Cameron & O'Leary (2023), when EA was high, teacher attitudes were enhanced by 37%. Chen et al. (2022) affirmed that ethical understanding and positive attitudes were highly correlated. Subsequent studies conducted by Debes (2021), supported by the current study, found positive correlations between EA and teachers' attitudes. Based on these findings, the following research hypothesis is presented:

H6: Ethical awareness positively influences language teacher attitudes toward generative AI.

Language Teacher Attitudes and Generative AI Implementation

Research on the impact of teacher attitudes on the GenAI implementation has identified several key relationships. A study by Nyaaba et al. (2024) showed that positive attitudes improve GenAI implementation outcomes. Similarly, empirical analysis by Lu et al. (2024) demonstrated that teachers' attitudes explained a small but statistically significant proportion of cross-sectional variation in GenAI implementation. In their study, Kong et al. (2024) hypothesized that positive attitudes predict the effectiveness of GenAI implementation. Further studies by Huang et al. (2024) confirmed the positive correlations between teachers' attitudes and successful GenAI implementation. In line with this, the hypothesis was formulated:

H7: Language teacher attitudes positively influence GenAI implementation.

Language Teacher Attitudes as Mediator

The research proved that positive teacher attitudes significantly increased the effectiveness of TS and PU in successful technology implementation (Bell-O'Leary, 2014). According to Pan (2020), teacher attitudes played a strong mediating role in technology adoption. To corroborate this, Kianinezhad (2024) subsequently demonstrated that teachers' attitudes mediated a significant proportion of the impact of EA on GenAI implementation. In a similar regional context, based on phenomenological interviews with university educators, Hamamra et al. (2025a; 2025b) report that teachers view AI in contradictory ways. These educators appreciate the usefulness of AI in classrooms, as well as the institutional support for its use. Positive attitudes are therefore based on enthusiasm, and initiatives to address inequities and fairness concerns regarding AI use are dismissed, thus reinforcing the model's explanatory logic. In line these, the hypothesis was formulated:

H8-H10: Language teacher attitudes mediate the relationships between technical support, perceived usefulness, ethical awareness, and GenAI implementation.

THEORETICAL FRAMEWORK

The Unified Theory of Acceptance and Use of Technology, also known as UTAUT, is a theoretical framework for predicting and explaining technology acceptance and usage behavior. The UTAUT was derived by Venkatesh et al. (2003) from eight different models, focusing on Technology Acceptance Model (TAM) and Theory of Planned Behavior (TPB). It reveals four key factors, namely performance expectancy, effort expectancy, social influence and facilitating conditions, which are directly related to user intentions and technology use behavior. This framework also includes control variables such as gender, age, experience and voluntary choice as part of the usage system, making this framework very versatile to any other context.

The present study is grounded in the Unified Theory of Acceptance and Use of Technology (UTAUT), which provides a theoretically established framework for explaining technology acceptance and use

through performance expectancy, effort expectancy, social influence, and facilitating conditions. Rather than treating all constructs in the present model as original UTAUT variables, this study adopts an extended and contextually adapted version of UTAUT to explain teachers' implementation of GenAI in language education.

Drawing on the extended UTAUT perspective described above, the present study specifies technical support, perceived usefulness, and ethical awareness as contextually relevant antecedents of GenAI implementation. Technical support represents the enabling conditions required for implementation, while perceived usefulness captures the performance-related evaluation of GenAI. Ethical awareness extends the conventional technology-acceptance perspective by accounting for teachers' recognition of the ethical responsibilities associated with GenAI use. Teachers' attitudes are subsequently positioned as a mediating mechanism through which these factors may influence GenAI implementation. The model therefore integrates both direct and indirect pathways to GenAI implementation.

THE RESEARCH FRAMEWORK

Based on previous studies, hypotheses were formulated to establish the variables' relationships. The relationships of the latent variables in this study are depicted in the research framework shown in Figure 1, illustrating the relationships between the independent and dependent variables. Specifically, the research framework specifies both direct and indirect relationships among the study constructs. Technical support (TS), perceived usefulness (PU), and ethical awareness (EA) are modelled as exogenous predictors of GenAI implementation (GAI), while language teacher attitudes (LTA) are specified as a mediating construct. Accordingly, the model examines the direct effects of TS, PU, and EA on GAI and the indirect effects of these three predictors on GAI through LTA.

METHODOLOGY

Sample and Data Collection

In the study, a quantitative cross-sectional study was conducted to analyse the relationships between the variables. The participants were all Secondary school English teachers across the country. To ensure sufficient representation across important demographic categories identified as moderators in UTAUT theory, a stratified random sampling approach was used. The stratification criteria included geographic regions to account for potential cultural and infrastructural variations in technology adoption, age groups, gender, and teaching experience levels. To moderate the risks of non-response bias and sample size errors, the sample size was increased by 10%, as Hair et al. (2021) recommended. Therefore, an extra 42 respondents (10% of 424) were added, making a total of the total selected sample to 467 teachers. A total of 364 respondents (78.2%) with 168 women and 196 men participated in this study, with the majority (76.8%) being between the ages of 30 and 40.

The research instrument used was a structured questionnaire that had been validated in previous studies. TS items were adapted from Compeau and Higgins (1995) and Thompson et al. (1991). The

measures of PU were modified from Davis (1989) and Teo (2011). The items on EA were adapted from Verma and Garg (2023). The teacher attitude measures were adopted from Nair & Das (2012). The items for the GenAI implementation, which in the context of this study is defined as the systematic integration and utilization of AI tools within language teaching practices, encompassing planning, assessment design, and instructional delivery activities, were adapted from Ivanov et al (2024). In this study, “implementation” was operationalized as the systematic integration of AI tools into instructional practice, encompassing frequency of tool usage and quality dimensions such as alignment with pedagogy, ethical compliance, and instructional effectiveness (Tarasenko & Petrushenko, 2024). Thus, in order to evaluate the quality of use, the study operationalized implementation quality using five different dimensions: professional development extent (training and skill acquisition in GenAI implementation), integration sophistication (alignment with pedagogical objectives), frequency metrics (usage patterns), functionality depth (range of AI capabilities employed), and outcome effectiveness (reported impacts on teaching and learning).

For this data, a 10-point Likert scale was used for the instrument, based on the considerations of Preston and Colman (2000), according to which scales with a larger number of response categories up to 10 points have a higher reliability and validity and a higher discriminatory power than scales with 5 or 7 points. The 10-point Likert scale was chosen for its greater sensitivity when assessing the acceptance of emerging technologies, as participants may have complex opinions that are difficult to map with shorter scales capture (Finstad, 2010; Revilla et al., 2014). The scale, according to Dawes (2008), is methodologically advantageous for the analytical approach. It increases reliability without compromising validity and improves compatibility with Partial Least Squares Structural Equation Modeling (PLS-SEM) analysis by providing greater variance in responses, increasing the accuracy of parameter estimation and improving model fit indices (Hair et al., 2019). More importantly, the decimal-based scoring system is consistent with Nigerian educational assessment practices, which uses 10-point and percentage-based assessments by default. This reduces cognitive load and improves respondent familiarity. It is also culturally appropriate for the Nigerian educational context and allows for advanced statistical analysis of factors influencing GenAI adoption (Nepal et al., 2019).

Table 1 Respondants’ Demography

Demographic characteristics	Category	Quantity
Gender	Male	196
	Female	168
	Non graduate	85
Academic Qualification	Graduate	256
	Post Graduate	23
Work Experience	0 to 5 years	165
	6-10 years	152
	11 years above	47

Participants were recruited from professional teacher groups via WhatsApp and Telegram using survey link (Google Form), along with details on the study's goals, data gathering techniques, and consent form. These groups, established by the English teacher association at the state level, aim to assist teachers in collaborative resource sharing, addressing classroom challenges, and providing opportunities for advancement in teaching and related fields. All participants hold professional teaching credentials and possess various qualifications (NCE, B.Ed., or equivalent). For analysis, only respondents who held at least a Nigeria Certificate of Education (NCE) were retained, while those without a teaching qualification were excluded. These respondents are classified as non-graduate teachers in the Nigerian Teacher Qualifications Framework, whereas holders of a B.Ed. or higher are classified as graduates. On the whole, the 78.2% response rate supports the representativeness of the sample.

Additionally, to evaluate the measurement invariance across mediator groups as well as construct validity and internal consistency, a pilot study was carried out with 50 teachers stratified across all demographic categories. As a necessary condition for effective moderation analysis, multigroup analysis was conducted to make sure the measurement model functioned similarly across gender, age, and experience groups. The start and end date of the data recruitment period were between 05/11/2025 and 03/01/2026. The Cronbach’s alpha coefficients of the reliability analysis were between 0.82 and 0.94, which is above the threshold value of 0.70 and indicates high reliability. The data analysis was performed with PLS-SEM using SmartPLS 4.0 software.

The choice of PLS-SEM was based on the fact that the study aimed to evaluate an extended UTAUT-based model and investigate the factors related to GenAI implementation in language education, not to replicate or validate the original UTAUT covariance structure. The model includes constructs that are adapted to the context and extended in theory, such as technical support, perceived usefulness and ethical awareness, and both direct and indirect relationships are explored via teachers' attitudes. The relationships among latent constructs can be estimated with PLS-SEM and the model can be valid and reliable for application in model development and prediction. It is also very beneficial when the research goal involves understanding the variation in important endogenous constructs and the mediation

effects. Therefore, it was deemed suitable for assessing the proposed extended model of GenAI implementation in language education context in Nigeria.

Although covariance-based SEM is well suited to confirmatory testing of established theoretical models and assessment of overall model fit, the present study focuses on explaining the variance in GenAI implementation within an extended and contextually adapted theoretical model, including the indirect effects of teachers' attitudes. For this reason, the prediction-oriented characteristics of PLS-SEM were considered more closely aligned with the objectives of the present study.

Data Analysis

The study examined an extended UTAUT model with multiple endogenous latent variables, one mediating latent variable, and one endogenous focus variable of GenAI implementation; therefore, PLS-SEM was used as the primary method. It was chosen because the study aimed to explain the variance in GenAI implementation in language education and to test the hypothesised direct and indirect relationships in the extended theoretical framework. Assessment of the measurement model and the structural model was conducted in two stages, in line with the PLS-SEM procedure (Hair et al., 2019). In the assessment of the measurement model, the reliability of the indicators (loadings > 0.70), the reliability of internal consistency (composite reliability > 0.70), the convergent validity (AVE > 0.50) and the discriminant validity were examined using the Fornell-Larcker criterion and the HTMT ratio. Also, the path coefficients and significance levels remained consistent across both subsamples, confirming the robustness of the estimated relationships.

The analysis of the structural model evaluation included the assessment of collinearity (VIF < 3.0), the significance of the path coefficients by bootstrapping (5000 replicate samples), the coefficient of determination (R^2), the effect size (f^2) and the predictive relevance (Q^2). Specific tests for indirect effects with bias-corrected confidence intervals were used in the mediation analysis. Ethical considerations included obtaining institutional approval, informed consent from participants, ensuring confidentiality through anonymous data collection, and secure storage of data. Participants were informed of their right to withdraw from the study at any time without consequences.

RESULTS

This section presents the results of this study, consisting of validity, reliability, path coefficients and hypothesis testing. The results are presented in two stages: assessment of the measurement model and assessment of the structural model.

Measurement Model

Regarding the validity and reliability of the data, the results show high internal consistency and satisfactory construct validity for all variables used. As shown in Table 2, the values for inter-rater reliability (Cronbach's alpha coefficient) was between 0.824 and 0.937 which is higher than the

recommended threshold 0.7, indicating high reliability. The composite reliability values were also between 0.872 and 0.950, which indicates an acceptable reliability of the constructs. The values for the average variance extracted (AVE) were between 0.531 and 0.761 and exceeded the threshold value of 0.5, which indicates sufficient convergent validity. Of the four constructs, EA had the highest reliability with (α=0.937) and an AVE of (0.761), suggesting that this measure is the most reliable among all the ones used in this study. These results confirmed the findings of Zhang et al. (2023) findings on the reliability of measurement constructs in educational technology research.

Table 2 Construct Reliability and Validity

Constructs	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
EA	0.937	0.938	0.950	0.761
GAI	0.900	0.906	0.923	0.667
LTA	0.824	0.828	0.872	0.531
PU	0.909	0.911	0.932	0.734
TS	0.895	0.903	0.923	0.706

In the same vein, the analysis of the outer loadings showed that the constructs achieved adequate item reliability for the constructs. As shown in Table 3, all items were above the recommended threshold of 0.7 and ranged from 0.706 to 0.888, indicating a high reliability of the individual items. These results are consistent with previous research by Thomas et al. (2024), where uniformly distributed loading patterns were observed in GenAI implementation research. Also, the particularly high loading coefficients for the EA items (0.849-0.888) support the assertion that ethical considerations are becoming more important in the use of educational technology. These results also confirmed that each item consistently defined the correct construct, thereby validating the measurement model.

Table 3 Outer loadings

Items	EA	GAI	LTA	PU	TS
EA1	0.849				
EA2	0.886				
EA3	0.880				
EA4	0.858				
EA5	0.871				
EA6	0.888				
GAI1		0.756			
GAI2		0.854			
GAI3		0.874			
GAI4		0.774			
GAI5		0.852			
GAI6		0.783			
LTA1			0.785		
LTA2			0.706		
LTA3			0.792		
LTA4			0.725		
LTA5			0.728		
LTA6			0.732		
PU1				0.871	
PU2				0.828	
PU3				0.887	
PU4				0.886	
PU5				0.808	
TS1					0.771
TS2					0.811
TS3					0.877
TS4					0.877
TS5					0.859

With reference to Table 4, the discriminant validity analysis showed that the constructs are independently strong while maintaining the theory-based relationships. The highest correlation coefficient (0.785) between PU and ethical awareness supports the interrelatedness of the PU and ethical awareness. Similarly, the moderate correlations found between LTA and other constructs, ranging from 0.626 to 0.703, also support Bell-O'Leary's (2014) study, which examined the mediating role of teacher attitudes in technology integration. These results demonstrate the distinctiveness of each construct, suggesting that they represent different components of the conceptual framework.

Table 4 Discriminants Validity

Constructs	**EA**	**GAI**	**LTA**	**PU**	**TS**
EA					
GAI	0.687				
LTA	0.626	0.703			
PU	0.785	0.724	0.686		
TS	0.688	0.690	0.641	0.765	

Regarding the cross-loading analysis, presented in Table 5, discriminant validity was established at the item level. Each item was most strongly associated with the intended construct, at least 0.2 stronger than the loading on any of the other constructs. The pattern of loadings showed an appropriate fit of the items to the construct, with primary loadings ranging from 0.706 to 0.888. These results also provided evidence for the discriminant validity of the measurement model at the indicator level, ensuring that each of the constructs measured was distinct from the others.

Table 5 Cross loadings

Items	EA	GAI	LTA	PU	TS
EA1	0.849	0.528	0.495	0.543	0.536
EA2	0.886	0.539	0.459	0.507	0.525
EA3	0.880	0.559	0.474	0.515	0.557
EA4	0.858	0.561	0.488	0.456	0.525
EA5	0.871	0.546	0.462	0.416	0.526
EA6	0.888	0.571	0.532	0.460	0.515
GAI1	0.521	0.756	0.541	0.559	0.483
GAI2	0.509	0.854	0.652	0.567	0.507
GAI3	0.558	0.874	0.647	0.572	0.575
GAI4	0.432	0.774	0.498	0.476	0.446
GAI5	0.557	0.852	0.462	0.570	0.550
GAI6	0.428	0.783	0.435	0.466	0.486
LTA1	0.418	0.588	0.785	0.434	0.419
LTA2	0.354	0.520	0.706	0.370	0.459
LTA3	0.293	0.503	0.692	0.338	0.332
LTA4	0.366	0.509	0.725	0.388	0.358
LTA5	0.462	0.541	0.728	0.549	0.399
LTA6	0.515	0.580	0.732	0.522	0.460
PU1	0.642	0.585	0.561	0.871	0.588
PU2	0.576	0.518	0.468	0.828	0.557
PU3	0.504	0.559	0.513	0.887	0.551
PU4	0.463	0.570	0.506	0.886	0.526
PU5	0.419	0.572	0.515	0.808	0.579
TS1	0.522	0.467	0.412	0.502	0.771
TS2	0.532	0.512	0.475	0.477	0.811
TS3	0.511	0.506	0.560	0.471	0.877
TS4	0.542	0.408	0.447	0.464	0.877
TS5	0.542	0.414	0.435	0.467	0.859

Additionally, the analysis of coefficient of determination and predictive value, presented in Table 6, showed that the model has a considerable amount of explainable variance. The coefficient of determination for the GenAI was calculated to be 0.700, meaning that 70% of the variance in the GenAI could be explained by the predictor variables, indicating strong predictive power. The LTA, on the other hand, yielded a moderate measure of shared variance with an $R^2 = 0.406$, which means that 40.6% of the variance was accounted for in the LTA. The Q-squared values (GAI = 0.457, LTA = 0.210) thus demonstrate the applicability of the proposed model for prediction processes, which underlines its practical significance. These results were higher than the values reported in similar studies (Kong et al., 2024, among others), indicating a better and more comprehensive explanation of variability in GenAI implementation in language education using the proposed model.

Table 6 Coefficient of Determination and Predictive Value

Constructs	R-square	Q-square
GAI	0.700	0.457
LTA	0.406	0.210

Finally, the effect size analysis showed different effects of the predictor variables. Table 7 presented that, of all the predictors, language teacher attitude had the highest correlation with GenAI (0.653), indicating a considerable influence. Ethical awareness had a moderate influence on the GenAI (0.240) and LTA (0.342). Moreover, both TS and PU showed moderate values between 0.208 and 0.225. These results emphasise the role of teachers' attitudes in influencing technology use in the classroom.

Table 7 Effect Size

Constructs	GAI	LTA
EA	0.240	0.342
LTA	0.653	
PU	0.208	0.339
TS	0.220	0.225

Structural Model (Hypothesis Test)

Using SmartPLS 4.0, the analytical method is converted into visuals. Figure 2 shows the diagram, where the arrows connecting the study's components point in the direction of the hypotheses proposed in the framework. Using single-headed arrows, the study construct's causal effect is confirmed. Based on the analysis of the results, the results of the study showed positive coefficients between the constructs in the proposed direct paths hypotheses. The analysis presented in Table 8 revealed that TS had a positive influence on GenAI ($\beta=0.128$, $t=3.359$, $p<0.001$), which supports H1. This result is consistent with Alqahtani and Wafula (2024) who found that TS improved the success of the AI implementation. The

result also confirms the pragmatic view of facilitating conditions in technology adoption emphasised by UTAUT.

Table 8 Path Coefficients

Hypotheses	Path Analysis	Beta Value	Standard deviation	T statistics	P values	Decision
H1	TS -> GAI	0.128	0.038	3.359	0.001	Supported
H2	PU -> GAI	0.092	0.039	2.383	0.017	Supported
H3	EA -> GAI	0.164	0.032	5.186	0.000	Supported
H4	TS -> LTA	0.196	0.045	4.378	0.000	Supported
H5	PU -> LTA	0.279	0.061	4.542	0.000	Supported
H6	EA -> LTA	0.231	0.056	4.123	0.000	Supported
H7	LTA -> GAI	0.574	0.027	21.218	0.000	Supported

Based on the findings presented in Figure 2, the results showed that PU had a positive effect on GAI ($\beta = 0.092$, $t = 2.383$, $p < 0.05$), supporting H2. This is consistent with Sugandini et al. (2018), who found that PU contributed 38% of the variance to GenAI implementation success. The relationship supports what UTAUT suggested about the role of PU in technology adoption. Similarly, the results show that ethical awareness has a positive significant relationship with GenAI ($\beta= 0.164$, $t=5.186$, $p<0.001$), which supports H3. This result was consistent with the UTAUT framework, which highlighted that ethical considerations play an important role in the quality of implementation. Additionally, TS was positively related to LTA ($r=0.196$, $F=4.378$, $P<0.001$), supporting H4, and PU also had a positive influence on LTA ($r=0.279$, $F=4.542$, $P<0.001$), supporting H5.

Furthermore, H7 was supported by the results as LTA had the highest direct influence on GenAI ($\beta=0.574$, $t=21.218$, $p<0.001$). This study filled the gap and extended the understanding of the UTAUT model by providing empirical evidence of the importance of teachers' pre-defined attitudes in the process of technology adoption.

On this note, the results presented in Table 9 showed that LTA had a mediating influence on all the proposed relationships based on the pre-specified hypothesis. More so, the relationship between TS and GAI via LTA was found to be significant ($\beta=0.112$, $t=4.309$, $p<0.001$), thus supporting H8. This supports the study by Li et al. (2019), which found that teachers' attitudes improved the effectiveness of TS.

Table 9 Mediation Results Using Indirect Effect

Hypotheses	Path Analysis	Beta Value	Standard deviation	T statistics	P values	Decision
H8	TS -> LTA -> GAI	0.112	0.026	4.309	0.000	Supported
H9	PU -> LTA -> GAI	0.160	0.035	4.551	0.000	Supported
H10	EA -> LTA -> GAI	0.133	0.033	4.058	0.000	Supported

The mediated model showed that PU had a significant indirect effect through LTA (β=0.160, t=4.551, p<0.001), supporting H9. This result is consistent with Pan's (2020) study on the mediating effect of attitudes on technology acceptance. Similarly, ethical awareness had a significant indirect effect through LTA (β=0.133, t=4.058, p<0.001), supporting H10. These mediation results were useful in addressing the theoretical gap by showing how teachers' attitudes bridged the gap between institutional support and individual perceptions of GenAI implementation practices. The study also extended the UTAUT model by including attitude as an important mediator of the link between TS and GenAI implementation success.

These finding revealed how such factors, such as, cultural, economic and infrastructural influenced Nigerian educational context. For example, relating these findings to Nigerian cultural values has an important influence on the acceptance of technologies. The prevalence of collectivist philosophy in Nigerian society can be used to explain why moral consciousness was a stronger predictor (β=0.164) than perceived usefulness (β=0.092), because shared values prioritise collective happiness over maximising individual utility. Also, the modest but significant effect of technical support (β=0.128) most likely reflects teachers' adaptive strategies rather than the optimal provision of support. This economic disadvantage is particularly evident in Nigeria, where most Nigerian schools do not have constant electricity and internet connectivity (Oshowole, 2024) and budgets for educational technology are very limited. Unlike in industrialised countries, the unreliable power supply, limited internet bandwidth and outdated hardware in Nigeria lead to erratic technology availability profiles, which may explain why the effects of experience moderation are and develop better adaptive strategies for uncertain Ubuntu philosophy in Nigerian society.

DISCUSSION

The empirical study presented above provides a range of research results that are relevant for the application of GenAI in language education. For example, the study proves the hypothesis that TS plays a role in GenAI implementation. This is in line with the study by Liu et al. (2023), who found that the implementation of TS improves the success of AI in schools. Similarly, Ofem et al. (2024) underscored the importance of TS in GenAI implementation. Rane et al. (2024) also found similar results, emphasising that improved TS increased the success rates of AI implementation. This consistency between the different educational contexts strengthens the theoretical assumption of UTAUT regarding the role and importance of enabling conditions for technology use and adoption.

In this regard, the hypothesis that postulates an influence of PU on GenAI implementation is supported by the empirical evidence. This result confirms the research of Huang et al. (2024) and showed that PU and GenAI implementation correlate strongly. Park et al. (2023) found similar patterns of how teachers' and other stakeholders' perceptions of the usefulness of AI influenced implementation outcomes. In other contexts, Rane et al. (2023) reported similar trends in PU and implementation outcomes. These cross-cultural regularities are again consistent with UTAUT's underlying assumption about the importance of PU for technology acceptance.

Furthermore, the study found that the hypothesis that ethical awareness increases with the adoption of GenAI was well supported. This result agrees well with the studies by Alahmed et al. (2023) in the field of education sector where an ethical concern of AI usage was revealed. Such studies show how ethical awareness improves the quality of GenAI implementation in language education. In the same context, they also reported similar trends between ethical understanding and implementation success. Overall, these findings extend the UTAUT by confirming the applied implications of ethical awareness in GenAI implementation across different cultures.

In the current study, the hypothesised relationship between TS and language teachers' attitudes is empirically confirmed. This research is in line with that of Zhai (2024), which also showed how TS affects teachers' attitudes towards AI. The research conducted by Nyaaba et al. (2024) revealed similar trends, focusing on the support systems that influence teachers' attitudes. For online education programmes, Lahiya and Mokodenseho (2024) found similar reasons for the relationship between technical infrastructures and teachers' perceptions.

Moreover, the study supports the hypothesis that PU has an influence on language teachers' attitudes. This finding is consistent with studies conducted by Bell-O'Leary (2014) in institutions examining how general perceptions of usefulness influence teachers' attitudes towards AI. Sugandini et al. (2018) found the same pattern in their research conducted in universities, even though the current study sought to understand the relationship between PU and teacher dispositions. Similar to the present study, Kianinezhad (2024) reported similar trends in the context of Iranian EFL education in terms of PU of different sources for teachers' attitudes.

To this end, mediation analysis shows statistically significant results for language teachers' attitudes. The empirical evidence for the hypothesis that teachers' attitudes play a central role in mediating the relationship between TS and GenAI implementation was confirmed. This finding is consistent with the research of Li et al. (2019), who showed how teachers' attitudes transformed TS into implementation practices. Such mediation effects were also reported by Chiu et al. (2023), with a particular focus on the importance of teachers' attitudes.

Moreover, the hypothesis that teacher attitudes play a mediating role in the relationship between PU and GenAI implementation is supported by previous findings. This was consistent with the research findings of Moses et al. (2013), which showed how attitude improved the effectiveness of PU on implementation

success. Similar mediation effects were found in Moorhouse and Kohnke's (2024) studies, which demonstrated that teachers' dispositions enhanced the impact of perceptions of usefulness.

Prior technology experiences have an overwhelming influence on GenAI attitudes. Unlike developed contexts where teachers have extensive prior technology experience, Nigerian teachers often encounter GenAI as one of their first challenging digital technologies. The stronger attitude-implementation link ($\beta = 0.574$) can be explained by the unique "leapfrog" effect, in which favorable initial encounters with GenAI lead to disproportionately positive attitudes.

Theoretically, this study advances UTAUT theory in several important ways. First, the use of ethical awareness as a predictor confirms its value in the context of GenAI adoption, particularly in collectivist cultures where communal considerations outweigh individual judgements of utility. The findings provide empirical support for selected mechanisms derived from UTAUT within an extended model of GenAI implementation in language education. Similarly, the mediating role of teacher attitudes provides a theoretical explanation for the process by which external influences affect implementation. In contrast to simple direct effect models, this mediated pathway suggests that successful AI implementation requires not only adequate resources and training, but also active processes of attitude change.

Finally, the findings confirmed that ethical awareness acts as a supportive determinant in the implementation of GenAI, thus supporting the theoretical claim that moral sensitivity fosters, rather than impedes, the adoption of technology in line with professional responsibility. Thus, the study provides evidence for the postulated hypothesis that there is some mediation of teacher attitudes towards ethical awareness and GenAI implementation. It was similar to the studies reviewed by Atalla et al. (2024) where a positive shift in teacher’s attitude was used to turn ethical sensitivity into effective implementation practices. Thus, the mediating roles mentioned in the study were consistent with the findings of Celik (2023) which highlighted how teacher disposition amplified the effects of ethical considerations.

IMPLICATIONS

This study has a number of pedagogical, theoretical and practical implications. From a pedagogical perspective, the study illustrates the importance of institutions designing teacher training courses that take into account the technical, ethical and practical aspects of GenAI implementation. The emphasis on the role of teachers’ attitudes leads to the conclusion that professional development should address not only technical skills but also positive dispositions, favouring and valuing AI technology through practice and successful outcomes.

Consequently, the study contributes to theory by developing a robust UTAUT model that enhances the exploration of technology use in education. This integration demonstrates that ethical issues are as important as PU and ease of use, broadening the theoretical lens on educational technology adoption. The strong mediating effects of teachers' attitudes also promote theoretical knowledge as they also raise awareness of teachers' attitudes as agents of change in the use of technology.

Practically, the study provides a clear roadmap for educational institutions wishing to implement GenAI. The importance of TS can be assessed; therefore, institutions should ensure that they have a strong infrastructure and support in place. Also, the impact of ethical awareness is high, which emphasises the need to develop specific ethical standards and establish ethical GenAI protocols for the use of GenAI in the educational context. This means that the PU of GenAI in language education should be effectively communicated by schools through the provision of pilot and success stories that demonstrate the actual benefits of GenAI. The findings also support the development of phased implementation approaches that take into account the technical, ethical and attitudinal issues; and caution that perceived usefulness, if pursued without adequate ethical grounding or workload management, may foster reliance and diminish pedagogical agency (Hamamra & Khlaif, 2025).

This study makes a substantial contribution to the empirical literature on the determinants of GenAI implementation. Despite its contribution, this study has several limitations. First, the study was only conducted among secondary school English teachers in Nigeria, which may limit its generalisability to other cultural contexts or levels of education (Haruna et al., 2024; Ibrahim et al., 2018). Since the data collection was cross-sectional, the study does not show how the relationships between the variables evolve over time. In addition, only the subjective reports were used in the assessment, which could be influenced by social desirability. Also, the need to promote pedagogically sound and ethically responsible AI practices is as important as encouraging adoption. Institutions must prioritise building capacity for originality in responsible AI use, constructive feedback, and sustainable fairness and transparency in assessments. These quality levers ensure that GenAI integration improves learning rather than merely increasing technology use.

Future research would benefit from longitudinal or experimental designs to assess the evolution of teachers' attitudes, ethical awareness, and the impact of institutional interventions on sustainable behavioural changes over time. Additionally, distinctions such as school type (public versus private), subject area, and seniority level may affect the availability of support and attitudinal shifts; moderation analysis among these groups would clarify contextual differences.

Beyond the model's focus on enablement, future studies could also adopt a "strain-based" perspective; such as technostress, work overload, and perceived complexity, to better understand the nuanced barriers and facilitators to GenAI adoption, as explored in previous research (Khlaif et al., 2025). Finally, qualitative methods, including interviews and classroom observations, would provide a deeper understanding of GenAI use and the underlying rational and ethical attitudes that inform the adoption of responsible GenAI use in actual teaching practice. Similarly, incorporating secondary outcome measures that assess pedagogical quality, such as creativity in lesson design, fairness in assessment, and depth of formative feedback, can deepen this work. These measures would help capture the purpose and intensity of GenAI integration.

CONCLUSION

As broached, the aim of this study was to investigate the effects of TS, PU and ethical awareness on GenAI implementation in language education, focusing on the mediating role of language teachers' attitudes. Overall, the present study showed consistent positive effects along all hypothesised paths. TS, PU and ethical awareness had significant direct effects on GenAI implementation with standardised coefficients of 0.128, 0.092 and 0.164 respectively. Language teacher attitude, as indicated in the model, was found to be the strongest factor influencing the success of GenAI implementation ($\beta = 0.574$). The results of the mediation analysis indicate that teacher attitude played a significant role in mediating the relationships between all independent variables and GenAI implementation, with indirect effects ranging from 0.112 to 0.160.

The study filled important knowledge gaps regarding the interactions between technical, perceptual and ethical aspects of GenAI implementation. However, it is clear from this study that these factors can be analysed in an integrated model to gain a better understanding of the relationships between them. With these results, the theoretical and practical knowledge on the successful GenAI implementation in language education has been enriched and the central importance of teachers' attitudes in technology integration has been emphasized.

Declarations

Ethical Approval

This study was approved by the Research Ethics Committee under the Directorate of Research Innovation and Development at Al-Qalam University Katsina, Nigeria (Approval No. AUK-REC/2025/012). The study was conducted in accordance with the ethical guidelines and regulations approved by the institutional ethics committee.

Consent to Participate

Written informed consent was obtained from all participants before their participation in the study.

Consent to Publish

As the manuscript contains no identifiable photographs, images, or personal case details, consent to publish is not applicable.

Author Contribution

Hamisu Hamisu Haruna: conceptualizationAzza Jauhar Ahmad Tajuddin: literature reviewIsyaku Hassan: manuscript coordinationMuhammad Naeem: review data and methodologyYosef Hasan Jbara: interpretation and technical expertiseImran Riaz Hasrat: comparative analysisBassam Elzaghmouri:

validation and investigationMarwan Ali Albahar: review and proof readingAtif Ikram: supervision and final approval

Data Availability Statement

The datasets generated and/or analysed during the current study are not publicly available due to participant confidentiality and ethical restrictions but are available from the corresponding author on reasonable request, subject to appropriate approval.

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Figures

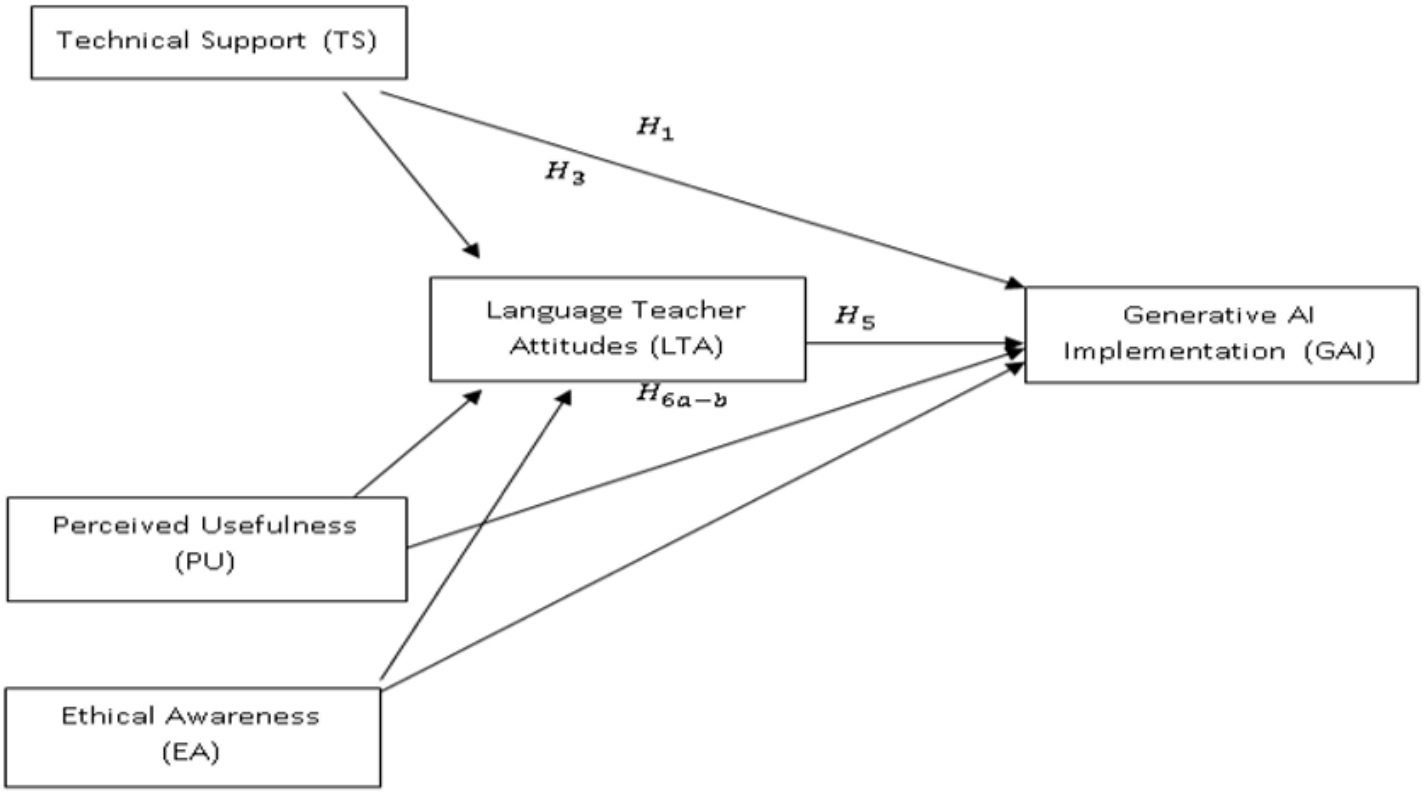

Figure 1

Research Framework

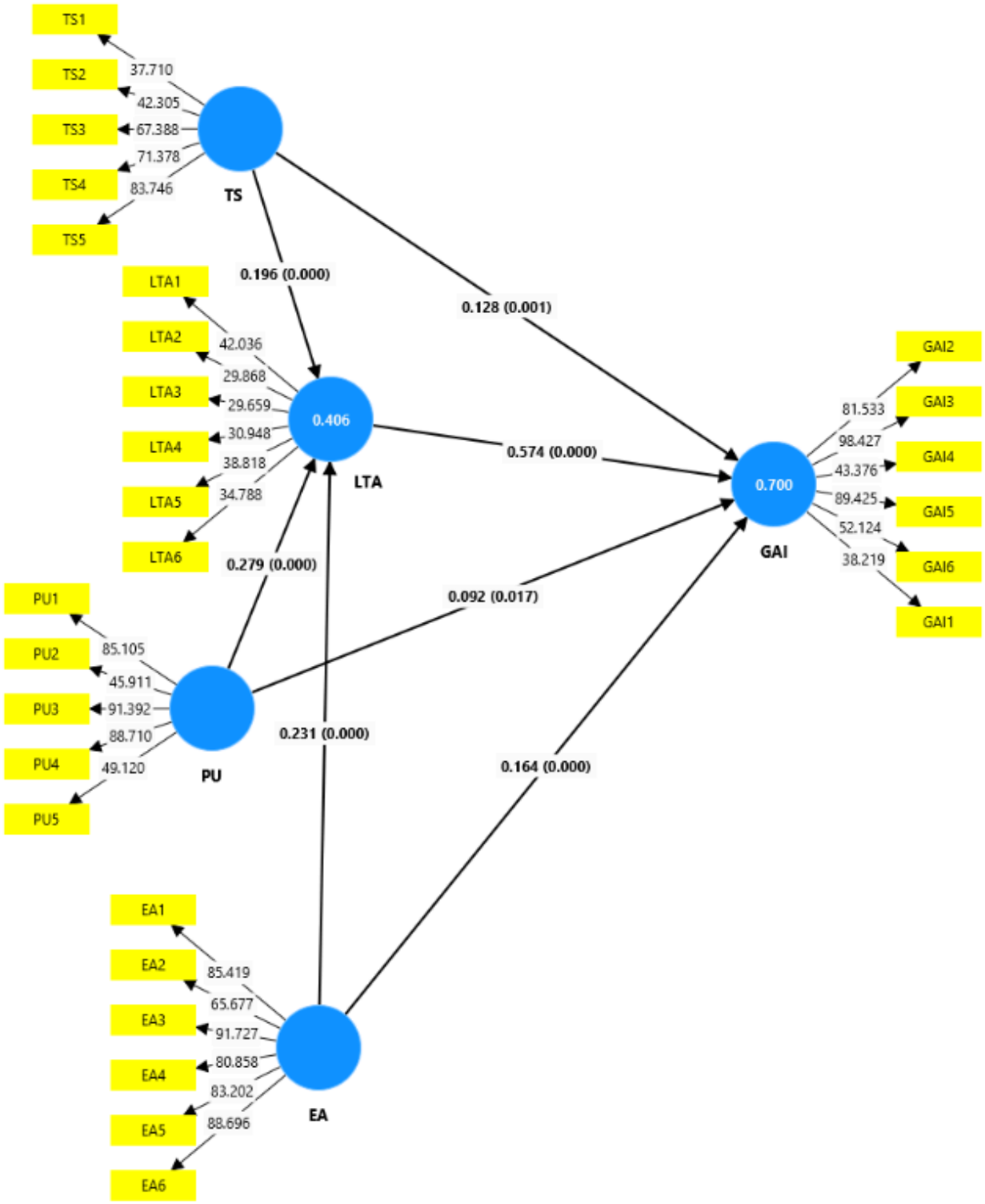

Figure 2

Graphical Results