EFL learners' grammar learning strategies in technology-enhanced contexts and relations to writing buoyancy and motivation

Hui Li
School of Foreign Languages, Xinyang College, Henan, China

Xiaojing Li (corresponding author)
School of Foreign Languages, Xinyang Normal University, Xinyang Henan, China

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ABSTRACT: This study conducted at Xinyang Normal University and Xinyang University in Henan Province explores the relationship between EFL learners' grammar learning strategies in technology-enhanced contexts and their writing buoyancy and motivation. Utilizing grammar learning strategies, buoyancy, and motivation questionnaires, 661 responses were collected. Structural Equation Modeling (SEM) was employed to analyze the data. The findings reveal a significant positive correlation between learning grammar strategies, motivation, and learners' buoyancy. Notably, over 50 percent of changes in buoyancy were predicted by grammar learning strategies in technology-enhanced environments. These results suggest implications for instructional practices and curriculum design, emphasizing the importance of understanding effective grammar learning strategies in fostering improved writing buoyancy and motivation. Educators can utilize these findings to tailor instruction to meet the specific needs of individual learners, thereby enhancing language learning outcomes.
Keywords: Grammar learning strategies, Technology-enhanced contexts, Writing buoyancy, Motivation, Curriculum design, Individualized instruction

Estrategias de aprendizaje de gramática de estudiantes de inglés como lengua extranjera en contextos potenciados por la tecnología y su relación con el dinamismo y la motivación para escribir

RESUMEN: Este estudio realizado en la universidad Normal de Xinyang y la universidad de Xinyang en la provincia de Henan explora la relación entre las estrategias de aprendizaje de gramática de los estudiantes de EFL en contextos mejor con la tecnología y su flotabilidad de escritura y motivación. Utilizando estrategias de aprendizaje de gramática, flotabilidad y cuestionarios de motivación, se recogieron 661 respuestas. Para analizar los datos se emplea un modelo de ecuaciones estructurales (MEE). Los hallazgos revelan una correlación positiva significativa entre el aprendizaje de estrategias gramaticales, la motivación y la flotabilidad de los estudiantes. Cabe destacar que más del 50 por ciento de los cambios en el dinamismo fueron predichos por las estrategias de aprendizaje de gramática en entornos mejores tecnológicamente. Estos resultados sugieren implicaciones para las prácticas instruccionales y el diseño curricular, haciendo hincapié en la importancia de la comprensión de estrategias eficaces de aprendizaje de la gramática en la promoción de la mejora de la

flotabilidad de la escritura y la motivación. Los educadores pueden utilizar estos resultados para adaptar la instrucción a las necesidades específicas de cada alumno, mejorando así los resultados del aprendizaje de idiomas.
Palabras clave: Estrategias de aprendizaje de gramática, contextos mejores tecnológicos, escritura dinámica, motivación, diseño curricular, instrucción individualizada

1. Introduction

AIn English as a Foreign Language (EFL) education, grammar learning is considered a critical component of language proficiency (Pawlak et al., 2023; Wang et al., 2024). With technology integration in educational contexts, there has been a shift towards technology-enhanced learning environments for language acquisition (Bozorgian et al., 2022; Habeb Al-Obaydi & Pikhart, 2022a; Zhang, 2024). These advancements provide new opportunities for EFL learners to employ various strategies in their grammar learning processes (Pawlak et al., 2016). This study aims to analyze the grammar learning strategies employed by EFL learners within technology-enhanced contexts and investigate the relationship between these strategies, writing buoyancy, and motivation. Understanding how learners utilize different techniques and the impact these strategies have on their writing and motivation can contribute to developing effective language learning methods (Wang et al., 2022).

The incorporation of technology in language learning offers numerous advantages, such as accessibility to a wide range of online resources, interactive exercises, and multimedia materials (Chau et al., 2023; Chen et al., 2023; Derakhshan & Shakki, 2020; Du, 2024; Kasim et al., 2024). Through technology-enhanced platforms, EFL learners have the opportunity to explore grammar rules, practice exercises, and receive immediate feedback on their performance (Solhi et al., 2023). This study explores how these technological resources influence learners' choices of grammar learning strategies and their subsequent impact on their writing buoyancy and motivation. Writing buoyancy, defined as the ability to overcome writing challenges and persist in the face of difficulties, is closely linked to motivation (Feng & Mohd Rawian, 2023; Zhang et al., 2017). By examining the relationship between grammar learning strategies, writing buoyancy, and motivation, this research aims to shed light on effective approaches to foster a positive learning experience for EFL learners in technology-enhanced grammar instruction (Soodmand Afshar & Jamshidi, 2022).

Technology-enhanced environments offer unique opportunities for EFL learners to engage with grammar instruction. Previous studies have shown the positive impact of technology on language learning outcomes and motivation (Teng & Zhang, 2020; Yang & Chen, 2007). However, limited research exists on the specific relationship between EFL learners' grammar learning strategies in technology-enhanced contexts, their writing buoyancy, and motivation. Understanding how EFL learners utilize different grammar learning strategies in technology-enhanced contexts is important for several reasons. Firstly, identifying the strategies learners employ in these settings can provide valuable insights into their preferred modes of engagement and the effectiveness of various technological resources. Secondly, investigating the link between these strategies, writing buoyancy, and motivation can shed light on how technology-enriched grammar instruction influences learners' confidence and perseverance in writing tasks. This knowledge can help educators design more targeted and effective grammar instruction to enhance writing skills (Zhang et al., 2017).

Furthermore, the investigation of writing buoyancy and motivation is crucial for fostering a positive learning experience and promoting sustainable language learning. Writing buoyancy reflects learners' ability to navigate challenges and setbacks in their writing efforts (Martin & Marsh, 2008). By exploring the relationship between grammar learning strategies, writing buoyancy, and motivation, this study aims to contribute to the understanding of the factors that affect EFL learners' engagement and persistence in writing tasks within technology-enhanced contexts. Through a comprehensive analysis of EFL learners' grammar learning strategies in technology-enhanced contexts and their associations with writing buoyancy and motivation, this study aims to bridge the gap in existing literature (Wang, 2024). The findings will provide insights into the effectiveness of technology in grammar instruction and its impact on learners' attitudes and experiences. This research can inform future instructional practices and curriculum design that foster effective grammar learning, enhance writing skills, and promote motivation within EFL contexts. The findings of this research can provide valuable insights for teachers, curriculum designers, and policymakers in enhancing grammar instruction and cultivating a motivating learning environment for EFL learners.

2. Review of the Literature

The incorporation of technology into language education has revolutionized how English as a Foreign Language (EFL) learners tackle the learning of grammar. In technology-enriched environments, learners have access to diverse resources and tools, fostering increased engagement and motivation (Durlak et al., 2011). This review delves into extant studies concerning EFL learners' strategies for mastering grammar within technologically enhanced settings. It investigates how these strategies correlate with writing buoyancy and motivation, shedding light on the intricate dynamics between technology, grammar acquisition, and students' psychological disposition towards writing and learning.

2.1. Impact of Technology-Enhanced Contexts on Grammar Learning

Numerous studies have delved into the influence of technology on language learning outcomes, consistently revealing notable advantages in the acquisition of grammar skills. Notably, research by Teo et al. (2022) demonstrated that the integration of technology into language learning approaches led to enhanced grammar accuracy and fluency among English as a Foreign Language (EFL) learners. This highlights the efficacy of technology-enhanced methodologies in facilitating more effective grammar instruction and practice.

Moreover, technology offers learners a plethora of accessible and interactive resources tailored to grammar acquisition. These include grammar applications, online exercises, and multimedia materials, among others, which cater to diverse learning styles and preferences. Wang et al. (2022) emphasized the significance of such resources in fostering individualized and self-paced learning experiences, allowing learners to engage with grammar content in ways that suit their specific needs and interests. The integration of technology into language learning not only enhances grammar acquisition but also provides learners with versatile tools and resources to engage with grammar content effectively. Through interactive platforms and tailored materials, technology empowers learners to take control of their learning process,

facilitating a more personalized and engaging experience that promotes sustained progress and proficiency in grammar skills.

2.2. Examining EFL Learners' Grammar Learning Strategies

Despite the advantages of technology in grammar learning, limited research has focused specifically on EFL learners' grammar learning strategies in technology-enhanced contexts. However, studies have explored the strategies employed in technology-mediated language learning more broadly. Some strategies identified include self-directed learning, collaborative learning, metacognitive strategies, and multimedia utilization (Thomas et al., 2024).

Self-directed learning is exemplified by learners' initiative in utilizing grammar resources and conducting independent practice via technology (Chen & Wang, 2017). This approach empowers learners to tailor their learning experiences to their individual needs and preferences, fostering a deeper understanding and mastery of grammar concepts. Collaborative learning entails learners engaging with peers on online platforms, participating in discussions, and offering feedback on each other's writing (Soodmand Afshar & Jamshidi, 2022; Xie & Derakhshan, 2021). Through collaboration, learners benefit from diverse perspectives, constructive critique, and collective problem-solving, which can enhance their grammar comprehension and writing proficiency. Metacognitive strategies, including goal setting, planning, progress monitoring, and reflective practices, can be effectively supported by technology-enhanced tools. These tools provide learners with frameworks and prompts to scaffold their metacognitive processes, leading to more strategic and effective grammar learning approaches. Multimedia utilization enables learners to leverage a variety of resources, such as videos and interactive exercises, to deepen their grasp and application of grammar rules (Pawlak, 2018). By engaging with multimedia content, learners can visualize concepts, interact with real-world examples, and reinforce their understanding through active participation, contributing to comprehensive grammar acquisition (Derakhshan et al., 2023; Pawlak, 2018).

2.3. Writing Buoyancy and Its Relation to Grammar Learning

The concept of writing buoyancy, which entails learners' resilience, persistence, and motivation in writing tasks, has emerged as a significant focus in writing studies. Research underscores its pivotal role in influencing writing performance and the overall writing process (Meyer, 2018). Strategies to cultivate and enhance writing buoyancy are of particular interest in educational contexts to support learners in navigating writing challenges effectively.

Despite the recognition of writing buoyancy's importance, there remains a gap in understanding how EFL learners' grammar learning strategies, especially in technology-enhanced environments, intersect with their writing buoyancy. While studies have explored various factors influencing writing performance, the specific relationship between grammar learning strategies in technology-enhanced contexts and writing buoyancy warrants further investigation. Understanding this relationship could inform instructional practices tailored to bolster both grammar proficiency and writing resilience among EFL learners. By delving into the interplay between grammar learning strategies in technology-enhanced settings and writing buoyancy, educators and researchers can refine instructional methodologies to better support

EFL learners in overcoming writing challenges and fostering sustained motivation in writing tasks. Addressing this research gap holds promise for enhancing both grammar acquisition and the overall writing proficiency of EFL learners in diverse learning environments.

2.4. Motivation in Grammar Learning within Technology-Enhanced Contexts

Motivation serves as a cornerstone in language acquisition, significantly shaping learners' levels of engagement, persistence, and ultimately, their overall success in language learning endeavors (Huy Pham, 2021; Momenzadeh et al., 2023; Wang, 2023). The integration of technology has emerged as a promising avenue to bolster learner motivation within language learning environments, as evidenced by previous research findings (Derakhshan & Shakki, 2024; Feng & Mohd Rawian, 2023; Yeh et al., 2019). Particularly in the realm of technology-enhanced grammar learning, various interactive features such as gamified activities, immediate feedback mechanisms, and interactive exercises have demonstrated the potential to augment learners' intrinsic motivation levels (Habeb Al-Obaydi & Pikhart, 2022b; Yeh et al., 2019).

The incorporation of technology into grammar learning not only introduces novel and engaging elements but also provides learners with opportunities for active participation and immediate reinforcement. Interactive exercises allow learners to interact with the content in dynamic ways, fostering a sense of autonomy and control over their learning process. Furthermore, gamified activities add an element of fun and challenge, motivating learners to persist in their efforts and engage more deeply with the material. Additionally, the provision of immediate feedback helps learners track their progress and make timely adjustments, contributing to a sense of accomplishment and further enhancing motivation levels (Huy Pham, 2021). However, limited research specifically investigates the influence of technology-enhanced grammar learning on motivation. Understanding how learners' grammar learning strategies in technology-enhanced contexts relate to their motivation can shed light on the factors that enhance or hinder learner motivation, guiding educators in designing motivating and engaging grammar learning experiences (Pourgharib & Shakki, 2024).

Examining the role of learner variables in the context of EFL learners' grammar learning strategies in technology-enhanced contexts is crucial. Language proficiency is a significant factor that shapes learners' approaches to grammar learning. The level of proficiency can influence the complexity of grammar rules learners focused on and the types of exercises they engage with (Chen & Wang, 2017; Mulugeta & Bayou, 2019; Pawlak, 2018). Prior experience with technology is another relevant variable. Learners who have had exposure to technology may exhibit greater autonomy, confidence, and proficiency in navigating technology-enhanced grammar resources (Wang, 2024). On the other hand, learners with limited experience may require explicit instruction and guidance in utilizing technology effectively (Chen & Wang, 2017; Durlak et al., 2011). Individual learner characteristics, such as learning styles and preferences, also play a role in grammar learning within technology-enhanced contexts. Some learners may prefer a collaborative learning environment and engage in fruitful discussions with peers, while others may thrive in individual self-directed learning (Zhang et al., 2017). Understanding these individual differences can inform instructional practices and strategies to cater to learners' diverse needs.

The literature review reveals that while there is research on technology-enhanced language learning and grammar acquisition, there is a research gap when it comes to understanding EFL learners' grammar learning strategies in technology-enhanced contexts and their relationships with writing buoyancy and motivation. By examining the impact of technology on grammar learning strategies, writing buoyancy, and motivation, future research can contribute to the development of effective instructional.

2.5. Research Questions

In consideration of the previously addressed concerns, questions were devised for the current examination.

RQ1. Is there any relationship between grammar learning strategies in technology-enhanced contexts, writing buoyancy, and motivation among EFL students?

RQ2. How much variance in the EFL students' writing buoyancy and motivation can be predicted by their grammar learning strategies in technology-enhanced contexts?

3. Method

3.1. Participants

A total of 661 questionnaires were received, of which 661 were valid. There were 62 male students, constituting 9.4% of the total sample, while female students numbered 599, comprising the majority at 90.6%. Among the students surveyed, 4.5% are majoring in Teaching, while the majority, constituting 47.7%, are focusing on Translation. Similarly, 47.8% of the students are majoring in Literature. This indicates a fairly balanced distribution between Translation and Literature majors, with Teaching being the least represented field among EFL students. The participants in the study ranged in age from 18 to 33 years old. Among the students surveyed, the majority (92.7%) fall within the age range of 18 to 25 years. A smaller percentage, 6.4%, are aged between 26 and 30 years. The smallest proportion, accounting for only 0.9%, consists of students aged 30 years and older. The majority, comprising 97.0%, hold a Bachelor of Arts (B.A.) degree. A smaller percentage, 2.7%, have a Master of Arts (M.A.) degree, indicating a minority of students with higher education qualifications. The least represented group consists of students with a Doctor of Philosophy (Ph.D.) degree, making up only 0.3% of the total sample. The data were collected in both Chinese and English within one week (from September 25, 2023 to October 3, 2023) from Xinyang Normal University and Xinyang University in Henan Province. 187 students participated in the questionnaire in Xinyang Normal University.

Table 1. Participants' demographic information

BACKGROUND INFORMATION	NUMBER	%
Gender		
Male	62	0.4
Female	599	0.6
Academic Qualification		
B.A.	641	7
M.A.	18	0.7
Ph.D.	2	0.3
Age		
18-25	613	2.7%
26-30	42	0.4%
+30	6	0.9%
Major		
Teaching	30	.5%
Translation	315	7.7%
Literature	316	7.8%
Total: 661		

3.2. Instruments

3.2.1. Learners' Grammar Learning Strategies Questionnaire

Adopted from Pawlak's Grammar Learning Strategy Inventory (2018), it has 18 items. With a five Likert-type scale, this tool is used to investigate the strategies students employ when learning grammar and how these strategies relate to language achievement (Hassanzadeh & Ranjbar, 2022). It aims to understand students' learning habits and improve their language learning outcomes. It has four subscales: metacognitive strategies, cognitive strategies, affective strategies, and social strategies. Reliability and validity assessments were carried out for this particular scale. It was piloted by 75 participants of the study, and the Cronbach alpha index was .79 (r = 79).

3.2.2. Learners' Academic Buoyancy Questionnaire

The Learners' Academic Buoyancy Questionnaire, developed by Theiyab Alazemi et al. in 2023 (Theiyab Alazemi et al., 2023), seeks to evaluate students' capacity to confront and surmount academic adversities. Comprising four items, it examines diverse facets of academic buoyancy, encompassing resilience, persistence, flexibility, and positive self-assurance. Typically, the questionnaire comprises prompts that probe students' reactions to academic hurdles and their beliefs in overcoming obstacles. These prompts may address stress management, resilience to setbacks, sustaining motivation, and seeking assistance when necessary. The questionnaire's outcomes offer insights into students' psychological resilience

and their adeptness in navigating academic challenges. Rigorous evaluations of reliability and validity were conducted for this questionnaire, which involved 75 study participants, yielding a Cronbach alpha index of .81 (r = 81).

3.3.3. Language Learners' Writing Motivation Scale

The Language Learners' Writing Motivation Scale, developed by Ardasheva et al. in 2012 (Ardasheva et al., 2012), is a tool aimed at gauging the motivation of language learners, specifically concerning writing tasks. This instrument assists researchers and educators in comprehending the various factors influencing learners' motivation to participate in writing activities. With its 37 items measured on a five-point Likert scale, the scale encompasses several subscales that delve into distinct aspects of writing motivation. These subscales were intrinsic motivation, extrinsic motivation, self-efficacy, task value, self-regulation, and anxiety. Rigorous reliability and validity assessments were undertaken, involving 75 participants, resulting in a high Cronbach alpha index of .92 (r = 92).

3.3. Procedure

Between September 25 and October 3, 2023, the researchers administered questionnaires at Xinyang Normal University and Xinyang University in Henan Province, assisted by Chinese EFL teachers. The data collection proceeded in two phases. Initially, we translated the questionnaires from English to Chinese to ensure inclusivity. This process involved forward and back translation, linguistic and cultural adjustments, and subsequent validation to maintain accuracy. After translating the questionnaire, three experts culturally adapted to it, considering sociolinguistic factors for relevance. The final stage assessed the translated version's reliability and validity, with three experts evaluating its face and content validity. In the subsequent phase, participants followed ethical guidelines, providing voluntary consent and receiving bilingual questionnaires via WeChat through Wenjuanxing. They were briefed on the research's purpose and the questionnaire's details, with assurances of anonymity and confidentiality. Each participant took 2-11 minutes to complete the survey. In total, 661 students participated, yielding 661 valid responses after eliminating unreliable data.

3.4. Data analysis

The researchers utilized advanced statistical software, including SPSS version 27 and AMOS version 24, to address their research inquiries. Their analytical approach focused on Structural Equation Modeling (SEM), facilitating the exploration of intricate relationships between variables. Within this framework, they employed various statistical functions to examine the dataset thoroughly. Functions like reliability analysis gauged the consistency of measured constructs, while correlation analysis unveiled the connections between variables. Additionally, Multiple Linear Regression allowed the researchers to assess the impact of multiple predictors on the outcome variable. By leveraging these sophisticated tools and methodologies, they conducted a comprehensive and systematic analysis, aiming to provide valuable insights into the research questions and their underlying dynamics.

4. Results

In the quest for thorough comprehension, the researchers extensively examined the questionnaire's reliability, focusing on both its convergent and discriminant validity. This rigorous analysis aimed to ensure not only the instrument's consistency and precision but also its ability to differentiate between different concepts. Armed with Confirmatory Factor Analysis (CFA), the researcher explored the complex dynamics of EFL students' grammar learning strategies, buoyancy, and motivation. Through this statistical method, they systematically investigated the underlying connections among these variables, revealing intricate relationships. The conclusion of this analytical process is evident in the detailed presentation of findings in subsequent tables and figures.

Table 2. Descriptive statistics of the variables

	N	MEAN	D	VARIANCE	SKEWNESS		KURTOSIS	
Grammar Learning Strategies	61	.33	.53	283	.523	.095	4.91	190
Metacognitive	61	3.64	.69	486	.764	.095	.59	19
Cognitive	61	3.69	.68	466	.927	.095	.85	19
Affective	61	2.05	.60	365	.497	.095	2.03	.19
Social	61	3.60	.86	751	.407	.095	21	19
Buoyancy	661	4.95	1.03	1.079	-.643	.095	.90	.19
Motivation	661	2.64	.54	.302	.143	.095	1.35	.19
Intrinsic	661	2.63	.63	.408	.471	.095	1.71	.19
Extrinsic	661	2.55	.62	.391	.317	.095	1.39	.19
Self-Efficacy	661	2.67	.62	.396	.063	.095	1.08	.19
Task Value	661	2.57	.60	.366	.192	.095	.90	.19
Self-Regulation	661	2.89	.69	.486	.004	.095	.32	.19
Anxiety	661	2.81	.56	.322	.112	.095	1.24	.19
Valid N (listwise)	661							

Table 2 presents descriptive statistics for various constructs, each assessed using a Likert scale. The statistics include measures of central tendency (mean), variability (standard deviation, variance), skewness, and kurtosis. For instance, "Grammar Learning Strategies" exhibit a mean score of 3.3321, indicating moderate levels, with low skewness and high kurtosis suggesting a peaked distribution. Conversely, "Social" constructs show lower mean scores and higher variability. These statistics aid in understanding the distribution and characteristics of each construct within the sample population.

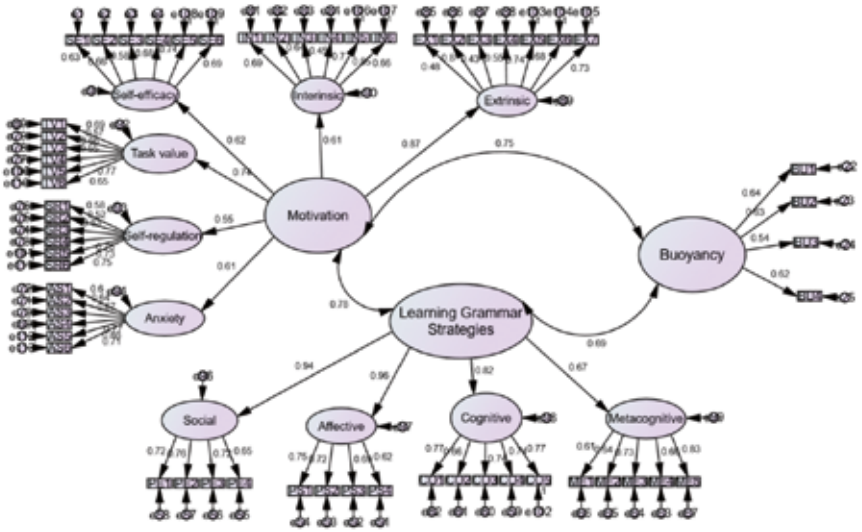

Figure 1. *The Final Modified CFA Model with Standardized Estimates*

Table 3. The goodness of fit estimation

		THRESHOLD			
Criteria		TERRIBLE	ACCEPTABLE	EXCELLENT	EVALUATION
CMIN	4397.094				
DF	2691				
CMIN/DF	1.634	> 5	> 3	> 1	Acceptable
RMSEA	.077		< 0.08	< 0.06	Acceptable
GFI	.931	> 0.8	> 0.9	> 0.95	Acceptable
CFI	.914	> 0.8	> 0.9	> 0.95	Acceptable
PNFI	.742		> 0.5		Acceptable
TLI	.937	> 0.8	> 0.9	> 0.95	Acceptable

The results displayed in Table 3 indicate that the model fit indices meet the predefined criteria. Specifically, the CMIN/DF ratio is calculated at 1.634, well below the threshold of 3.0. The Goodness of Fit Index (GFI) is 0.931, exceeding the criterion of 0.9, suggesting a strong model fit. Similarly, the Comparative Fit Index (CFI) at 0.914 meets the recommended threshold. The Parsimonious Normed Fit Index (PNFI) is 0.742, surpassing the acceptable limit of 0.5, supporting the model's adequacy. Additionally, the Tucker-Lewis Index (TLI) at 0.937 aligns with the guideline of 0.9 for a satisfactory fit. Finally, the Root Mean Square Error of Approximation (RMSEA) is 0.077, below the upper limit of 0.080, indicating precise fit. Overall, the thorough examination of these model fit indices confirms the appropriateness and accuracy of the proposed model according to the predetermined criteria.

Table 4. Reliability and validity of the variables

	CR	AVE	MSV	MAXR(H)	GRAMMAR STRATEGIES	BUOYANCY	MOTIVATION
Grammar Strategies	0.81	0.75	0.801	0.796	0.866		
Buoyancy	0.80	0.73	0.799	0.854	0.753***	0.856	
Motivation	0.89	0.69	0.809	0.863	0.655***	0.718***	0.828
*** It is significant at .000 level							

The results from Table 4 confirm the reliability of both composite and construct measures used. Furthermore, all measures demonstrate Average Variance Extracted (AVE) values above 0.50, validating convergent and discriminant validity. Moreover, a strong positive correlation ($r = 0.753$, $p < .001$) between grammar strategies and buoyancy was observed, suggesting that greater engagement in grammar-related activities encourages students' buoyancy. The data in the figure supports the notion that involvement in grammar strategies influences students' creative potential. This understanding sheds light on how grammar strategy experiences impact buoyancy in academic contexts, providing insights for educational practices to foster creativity in students.

The data analysis unveiled a strong and positive connection between the use of grammar strategies and motivation, supported by a correlation coefficient of 0.655 ($p < .001$). This suggests that individuals employing more grammar strategies tend to have higher motivation levels. Additionally, a similar positive correlation emerged between motivation and buoyancy, with a correlation coefficient of 0.718 ($p < .001$), indicating that motivated individuals are prone to heightened emotional states. The statistical significance underscores the intertwined nature of motivation, grammar strategies, and emotional experiences. These findings indicate that nurturing motivation not only positively impacts buoyancy but also influences emotional states, underscoring the complex relationship among grammar strategies, motivation, and buoyancy.

Table 5. Standardized regression weights of the variables

			STANDARDIZED REGRESSION WEIGHTS	S.E.	C.R.	P
Buoyancy	↔	Grammar Strategies	.691	.284	.489	.002
Motivation	↔	Grammar Strategies	.783	.225	.497	.001

The analysis of direct relationships within the model, outlined in Table 5, provides compelling insights into the interaction among various factors and student motivation. Firstly, empirical evidence shows that students' use of grammar strategies significantly boosts their buoyancy ($\beta = .691$, $p < .002$), emphasizing the crucial role of these strategies in fostering positive mental states. Additionally, the investigation reveals a substantial positive impact of grammar strategies on students' motivation ($\beta = .783$, $p < .001$), highlighting the intricate relationship between these strategies and students' overall mental well-being. These findings underscore the importance of grammar strategies in shaping students' motivation and buoyancy, offering valuable insights into the complex nature of student mental health and the positive influence of grammar strategies on their emotional and psychological welfare.

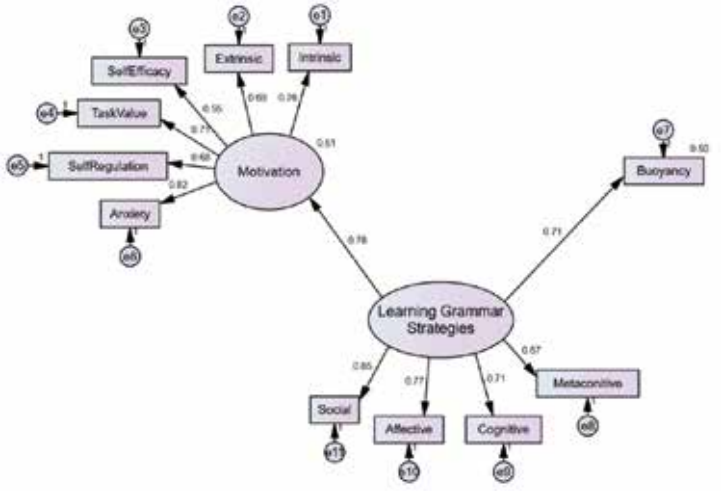

Figure 2. *The Final measurement model*

Table 6. Structural model assessment

PARAMETER	ESTIMATE	LOWER	UPPER	P
Motivation	.784	.042	.317	.002
Buoyancy	.713	.016	.214	.001

The results from Table 6 highlight a vital aspect of students' resilience, demonstrating that about half of the observed differences can be attributed to grammar learning strategies ($\beta = .50$, $p < .001$). This indicates that more than half of the changes in students' resilience are influenced by their grammar learning approaches in technology-integrated settings. The statistical significance of the beta coefficient ($\beta = .50$) underscores the substantial impact of this connection on students' resilience, further supported by a p-value of less than .001. Additionally, grammar learning strategies in technology-enhanced environments significantly forecast students' motivation, with approximately 61% of the variations linked to these strategies ($\beta = .61$, $p < .001$). These findings emphasize the interconnectedness of grammar learning strategies in technology-rich settings in shaping both motivation and resilience among learners. This suggests a meaningful relationship between these variables, extending beyond mere correlation. Therefore, fostering a supportive environment for creative expression and emotional well-being could be pivotal in promoting optimal psychological health among students.

5. DISCUSSION

The findings from the study underscore the interconnectedness between learning grammar strategies, motivation, and learners' buoyancy, highlighting a positive and significant relationship among these factors. This suggests that learners who employ effective grammar

learning strategies tend to exhibit higher levels of motivation, which in turn contributes to their resilience and adaptive coping strategies, as indicated by their buoyancy levels. Moreover, the study reveals that learning grammar strategies play a crucial role in predicting changes in learners' buoyancy, with more than 50 percent of these fluctuations being attributable to the utilization of such strategies within a technology-enhanced learning environment.

The significant role of technology in enhancing learners' buoyancy is further supported by research emphasizing the positive impact of technology-assisted educational tools on various aspects of language learning, including speaking performance and academic achievement. Embracing technology in language education not only expands the scope of instructional methods but also cultivates a supportive learning environment conducive to learners' emotional well-being and academic success (Pawlak, 2018). Educators can improve language learning by integrating technology, grammar learning strategies, motivation, and buoyancy into their teaching methods. Understanding the strategies learners use with technology helps identify effective resources and tools. Key strategies in technology-enhanced learning include self-directed learning, collaborative learning, and metacognitive strategies. Self-directed learning involves independent practice using grammar websites or apps, while collaborative learning includes online discussions and virtual grammar activities. Metacognitive strategies, such as goal-setting, progress monitoring, and reflection, are also essential (Meyer, 2018; Pawlak et al., 2016; Zhang, 2024).

By exploring the relationship between grammar learning strategies and writing buoyancy, researchers can gain insights into how these strategies influence learners' resilience in the face of writing challenges. For instance, learners who employ effective grammar learning strategies in technology-enhanced contexts may develop a stronger sense of writing buoyancy, as they become more confident in applying grammar rules accurately while writing (Teng & Zhang, 2020; Wang, 2024). On the other hand, inadequate use of grammar learning strategies might hinder learners' writing buoyancy, impacting their motivation and persistence in writing tasks. By exploring the connection between grammar learning strategies and motivation in technology-enhanced contexts, researchers can shed light on the factors that enhance or hinder learner motivation. For example, utilizing interactive grammar exercises and gamified activities might increase learners' intrinsic motivation and engagement. Conversely, an over-reliance on technology without a deliberate focus on meaningful grammar learning activities could potentially decrease learners' motivation (Yang & Chen, 2007; Zhang, 2024).

Another important aspect to consider in the analysis of EFL learners' grammar learning strategies in technology-enhanced contexts is the role of learner variables. Factors such as language proficiency, prior experience with technology, and individual learner characteristics may influence the choice and effectiveness of grammar learning strategies (Zhang et al., 2017). Language proficiency plays a crucial role in selecting appropriate grammar learning strategies. For instance, learners at higher proficiency levels may focus on more complex rules or engage in critical analysis of grammar usage, whereas beginners may need to focus on fundamental rules and basic exercises to build a strong foundation (Teng & Zhang, 2020).

Prior experience with technology can also shape learners' approaches to grammar learning. Learners who are familiar and comfortable with technology may exhibit greater autonomy and confidence when utilizing different resources. On the other hand, learners with limited exposure to technology may require additional guidance and support to navigate technolog-

ical tools effectively. Individual learner characteristics, such as learning styles, preferences, and cognitive abilities, should also be considered (Chen & Wang, 2017; Meyer, 2018; Mulugeta & Bayou, 2019; Pawlak, 2018). Some learners may excel in collaborative learning environments, while others may perform better when working individually. Recognizing and accommodating these individual differences can help teachers design technology-enhanced grammar learning experiences that cater to diverse learner needs.

6. Conclusion

The study's findings suggest a strong correlation between the use of grammar learning strategies, motivation, and learners' buoyancy. Firstly, it highlights a positive and significant relationship between the adoption of grammar learning strategies and motivation. This indicates that learners who actively employ effective grammar learning strategies are more likely to exhibit higher levels of motivation in their language learning endeavors. Such a correlation underscores the importance of employing tailored strategies to enhance both motivation and grammar competence simultaneously.

Moreover, the study sheds light on the significant predictive power of grammar learning strategies on learners' buoyancy, particularly in technology-enhanced learning environments. It reveals that over 50 percent of changes in learners' buoyancy can be anticipated by their engagement with grammar learning strategies. This suggests that the effective utilization of grammar learning strategies not only contributes to improved grammar competence but also plays a pivotal role in fostering learners' resilience and positive attitudes towards language learning challenges. These findings underscore the multifaceted benefits of integrating grammar learning strategies into language instruction, especially within technology-enhanced learning environments. By recognizing the intertwined relationship between motivation, grammar learning strategies, and buoyancy, educators can tailor their instructional approaches to enhance learners' overall language learning experiences. Employing a combination of motivational techniques and targeted grammar instruction can help cultivate a conducive learning environment that promotes both academic success and psychological well-being among language learners. The study's findings emphasize the intricate interplay between learning strategies, motivation, and buoyancy in language learning contexts. It underscores the importance of adopting effective grammar learning strategies to not only enhance grammatical competence but also to foster learners' motivation and resilience. These insights can inform the development of more tailored and effective language instruction methods, ultimately enriching learners' overall language learning experiences.

7. Implications for instructional practices and curriculum design

The findings from this study can inform instructional practices and curriculum design in several ways. Firstly, understanding the grammar learning strategies that lead to improved writing buoyancy and motivation can help educators design effective learning environments that foster these outcomes. Teachers can incorporate technology in ways that encourage learners to employ metacognitive strategies, collaborate with peers, and engage in reflection and goal-setting to enhance grammar learning and overall writing performance. By leveraging

digital tools such as online platforms, interactive exercises, and writing software, educators can create dynamic and interactive learning experiences that cater to diverse learner needs. Additionally, integrating effective grammar instruction into the curriculum involves reteaching skills and strategies that are not mastered, developing small-group and individual mini-lessons, and employing instructional practices encompassing transcription, grammar, vocabulary, text structures, and more. This holistic approach ensures that learners receive comprehensive support to enhance their writing skills and motivation levels.

Secondly, identifying the factors that influence learner motivation within technology-enhanced contexts can guide educators in designing motivating tasks and activities that align with learners' interests and preferences. By leveraging the interactive and personalized features of technology, instructors can create engaging and dynamic grammar learning experiences that promote intrinsic motivation and learner autonomy. Strategies such as gamification, virtual reality simulations, and interactive multimedia materials can be integrated into grammar instruction to enhance learner engagement and motivation. Additionally, fostering a sense of purpose and belonging among learners can further enhance motivation levels and promote a positive learning environment. Moreover, incorporating self-regulated learning strategies enables learners to take ownership of their learning process, fostering autonomy and intrinsic motivation.

Lastly, recognizing the impact of learner variables can help educators tailor instruction to meet the specific needs of individual learners. Providing differentiated support and guidance based on learners' language proficiency levels, prior experience with technology, and personal characteristics can enhance the effectiveness of grammar learning interventions in technology-enhanced contexts. Understanding learners' language proficiency levels allows instructors to scaffold instruction appropriately, offering additional support for struggling learners while providing more challenging tasks for advanced students. Additionally, considering learners' prior experience with technology enables educators to design activities that build upon existing knowledge and skills, fostering a seamless integration of technology into the learning process. Moreover, acknowledging learners' personal characteristics, such as their learning preferences and motivation levels, allows instructors to tailor instruction in ways that promote engagement and motivation. By addressing these learner variables, educators can create more inclusive and effective grammar learning environments that cater to the diverse needs of all students.

8. Limitations and future studies

As noted, the study sample had a significant gender imbalance, with female students comprising the majority. This gender disproportionality may limit the generalizability of the findings and could introduce potential biases in the results. Future studies should aim for a more balanced representation of genders to ensure greater diversity and representativeness in the participant sample. While the study included a substantial number of participants, it's essential to acknowledge that a larger sample size could further enhance the study's statistical power and reliability of the results. A larger and more diverse sample could provide a more comprehensive understanding of the relationships between grammar learning strategies, writing buoyancy, and motivation among EFL students. The study utilized a cross-sectional

design, which limits the ability to establish causal relationships between variables. Future research could employ longitudinal or experimental designs to investigate the causal effects of grammar learning strategies in technology-enhanced contexts on writing buoyancy and motivation over time.

Future studies should aim to recruit participants with a more balanced male-female ratio to ensure gender equity and diversity in the sample. This would allow for a more comprehensive exploration of how gender influences the relationship between grammar learning strategies, writing buoyancy, and motivation among EFL students. Conducting longitudinal studies would enable researchers to examine the long-term effects of grammar learning strategies in technology-enhanced contexts on writing buoyancy and motivation. By tracking participants' progress over an extended period, researchers can better understand the dynamic nature of these relationships and identify potential causal pathways. Employing experimental designs would allow researchers to manipulate variables and establish causal relationships between grammar learning strategies, writing buoyancy, and motivation. Experimental studies could involve interventions aimed at enhancing grammar learning strategies through technology-enhanced methods and assessing their impact on writing buoyancy and motivation outcomes. Incorporating qualitative methods, such as interviews or focus groups, alongside quantitative measures could provide deeper insights into students' experiences, perceptions, and attitudes regarding grammar learning in technology-enhanced contexts. Qualitative inquiry can offer rich data to complement quantitative findings and enrich our understanding of the complex interplay between variables. By addressing these limitations and incorporating the suggested recommendations, future studies can build upon the existing research and contribute to a more nuanced understanding of the relationships between grammar learning strategies, writing buoyancy, and motivation among EFL students in technology-enhanced contexts.

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