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Research Article

The Effects of Technology-based English Grammar Instruction on English Major Students' Learning Strategies, Grammar Achievement, and Perceptions

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Abstract

As technology continues to evolve, its integration into education has garnered significant attention. Despite the growing body of knowledge regarding educational technology in various fields, there is limited information on the use of technology to support learning strategies, particularly within the context of Thailand. This study aims to address this gap by examining the effects of technology-based grammar instruction on: 1) students' use of English grammar learning strategies (GLS); 2) students' grammar achievement; and 3) students' perceptions of technology-based grammar instruction. This quasi-experimental research design collected data from two groups: an experimental group and a control group. The experimental group consisted of thirty-five First-Year English major students who received technology-based grammar instruction. Meanwhile, the control group, which comprised thirty-four students from the same course, followed the traditional instruction without technology integration and the researcher was not their instructor. The research instruments included

Grammar Learning Strategy Inventory (GLSI), pre-tests and post-tests, and focus group interviews with six volunteers from the experimental group. The quantitative data was statistically analyzed by frequency, percentage, means, and standard deviation. This included conducting a t-test to compare the scores of the experimental and control groups. Thematic analysis was employed to analyze qualitative data from the focus group interviews. The findings revealed that while technology-based grammar learning activities did not significantly affect students' use of GLS, they did improve grammar achievement. Additionally, the results showed both positive and negative perceptions among students regarding the use of technology for grammar learning. This study underscores the importance of integrating technological tools into teaching to improve students' English grammar learning outcomes.

Keywords: Technology-based English Grammar Instruction, English Grammar Learning Strategies (GLS), English Grammar Learning Activities

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บทความวิจัย

ผลกระทบของการสอนไวยากรณ์ภาษาอังกฤษโดยใช้เทคโนโลยีเป็นฐาน ที่มีต่อกลวิธีการเรียนไวยากรณ์ ผลสัมฤทธิ์ทางการเรียนไวยากรณ์ และการรับรู้ของนักศึกษาวิชาเอกภาษาอังกฤษ

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บทคัดย่อ

ในยุคที่เทคโนโลยีก้าวหน้าไปอย่างรวดเร็ว การนำเทคโนโลยีมาใช้ในด้านการศึกษาจึงได้รับความสนใจอย่างแพร่หลาย อย่างไรก็ตาม ถึงแม้จะมีการพัฒนาองค์ความรู้เกี่ยวกับเทคโนโลยีการศึกษาในหลากหลายสาขา องค์ความรู้ด้านการใช้เทคโนโลยีเพื่อสนับสนุนกลวิธีการเรียนโดยเฉพาะอย่างยิ่งในด้านไวยากรณ์ในปัจจุบันยังมีไม่มากเท่าที่ควร โดยเฉพาะในบริบทของประเทศไทย งานวิจัยนี้จึงมีวัตถุประสงค์เพื่อศึกษาผลกระทบของการใช้กิจกรรมการเรียนรู้ไวยากรณ์ภาษาอังกฤษโดยใช้เทคโนโลยีเป็นฐานที่มีต่อ 1) การใช้กลยุทธ์การเรียนไวยากรณ์ภาษาอังกฤษ 2) ผลสัมฤทธิ์ทางการเรียนไวยากรณ์ภาษาอังกฤษ และ 3) การรับรู้ของผู้เรียนเกี่ยวกับกิจกรรมการเรียนรู้ไวยากรณ์ภาษาอังกฤษโดยใช้เทคโนโลยีเป็นฐาน งานวิจัยกึ่งทดลองนี้เก็บข้อมูลจากกลุ่มทดลองและกลุ่มควบคุม โดยกลุ่มทดลองเป็นนิสิตวิชาเอกภาษาอังกฤษชั้นปีที่ 1 จำนวน 35 คนที่ได้รับการสอนด้วยชุดกิจกรรมการเรียนไวยากรณ์ภาษาอังกฤษโดยใช้เทคโนโลยีเป็นฐาน ในขณะที่กลุ่มควบคุมประกอบด้วยนิสิตจำนวน 34 คน ได้รับการสอนด้วยวิธีการดั้งเดิมโดยไม่ได้เน้นเรื่องการใช้เทคโนโลยีเป็นสำคัญ และผู้วิจัยไม่ใช่อาจารย์ผู้สอนกลุ่มดังกล่าว เครื่องมือวิจัยประกอบด้วยแบบวัดกลวิธีการเรียนไวยากรณ์ แบบทดสอบไวยากรณ์ก่อนและหลังเรียน และมีการเก็บข้อมูลเชิงคุณภาพผ่านการสัมภาษณ์กลุ่มกับอาสาสมัครจำนวน 6 คนจากกลุ่มทดลอง ผู้วิจัยใช้สถิติพื้นฐานโดยการแจกแจงความถี่ ร้อยละ ค่าเฉลี่ย ส่วนเบี่ยงเบนมาตรฐานในการวิเคราะห์ข้อมูลเชิงปริมาณ และการทดสอบ t (t-Test) เพื่อเปรียบเทียบคะแนนของกลุ่มทดลองและกลุ่มควบคุม นอกจากนี้ผู้วิจัยใช้การวิเคราะห์แก่นสาระเพื่อวิเคราะห์ข้อมูลเชิงคุณภาพจากการสนทนากลุ่ม ผลการวิจัยพบว่า ชุดกิจกรรมการเรียนไวยากรณ์ภาษาอังกฤษโดยใช้เทคโนโลยีเป็นฐานไม่ได้สร้างความแตกต่างในระดับการใช้กลยุทธ์การเรียนไวยากรณ์ของผู้เรียนทั้งก่อนและหลังเรียน แต่ส่งผลเชิงบวกต่อผลสัมฤทธิ์ทางการเรียนไวยากรณ์ภาษาอังกฤษของผู้เรียน นอกจากนี้ผู้เรียนยังมีการรับรู้เชิงบวกและเชิงลบเกี่ยวกับการใช้เทคโนโลยีในการเรียนไวยากรณ์ งานวิจัยนี้ชี้ให้เห็นถึงความสำคัญของการเรียนการสอนที่ผสมผสานเทคโนโลยีรูปแบบต่าง ๆ เพื่อพัฒนา และเพิ่มผลสัมฤทธิ์ในการเรียนไวยากรณ์ภาษาอังกฤษของผู้เรียนให้มีประสิทธิภาพมากที่สุด

คำสำคัญ: การสอนไวยากรณ์ภาษาอังกฤษโดยใช้เทคโนโลยีเป็นฐาน กลวิธีการเรียนไวยากรณ์ภาษาอังกฤษ
ชุดกิจกรรมการเรียนไวยากรณ์ภาษาอังกฤษ

Introduction

Grammar is an essential skill for learning the English language, especially when studying it as a second or foreign language. Learners are able to use English accurately and appropriately when they have a good knowledge of English grammar. This subsequently leads to the development of other language skills such as listening, speaking, reading, and writing (Ellis, 2006). Despite its importance, many students find that learning grammar is challenging and complicated. It is a teacher's job to help students overcome the challenges of learning grammar and achieve proficiency in English language usage. A variety of learning approaches have been suggested to be incorporated by teachers to help learners understand how they learn best. One notable approach in this regard is the employment of Grammar Learning Strategies (GLS), as advocated by scholars such as Cohen (2011), Chamot and Harris (2019), and Pawlak (2016). According to Pawlak (2016), GLS can promote learning autonomy and facilitate successful grammar learning. Similarly, Cohen and Weaver (1998) emphasized that learners who are not trained and encouraged to use learning strategies will lack the skills to adapt learning strategies to their own benefit.

Therefore, teachers must create opportunities for students to experiment with a variety of strategies and engage in learning experiences both inside and outside the classroom. One effective way to help create engaging and efficient learning experiences for learners is by integrating technology into teaching. Due to the rapid development of technology, teachers have unlimited access to information, which results in diverse and more effective teaching media (Santos et al., 2018). Utilizing technology such as electronic devices, multimedia, or digital resources with language learning activities can create motivation and inspire learners throughout the learning process (Adara & Haerani, 2021; Byrnes & Wasik, 2009; Roy, 2019; Yoon, 2013). Several researchers have suggested using technology as part of motivational strategies for learners (Alizadeh, 2016; Al Kaboody, 2013; Deldeniya, Khatibi, & Asam, 2018; Mahmoudi, 2020).

As a result, today's teachers are interested in using technology to teach grammar effectively, as evidenced by several studies that explore the benefits and importance of incorporating technology into grammar instruction (e.g., Cam & Tran, 2017; Saeedi, & Biri, 2016; Summerhays, 2020). It has become crucial even in contexts with limited resources (Hockly, 2014). Furthermore, the efficacy of digital teaching tools used in grammar instruction has recently been an area of research interest, including web-based learning (Summerhays, 2020; Zaman, 2022), video-based learning (Perdani, 2022), mobile applications (Kashanizadeh & Shahrokhi, 2021; Purgina et al, 2020; Vu et al., 2023), Mobile-Assisted Language Learning (MALL) tools (Refat et al., 2020), gamified learning (Hashim et al., 2019; Waluyo et al., 2023), and multimedia instruction using animated situation comedies (Saeedi & Biri, 2016). Some educators have concluded that technology has revolutionized the way grammar is taught and how GLS is used by students (Conrad, 2000; Johns, 1991).

However, despite the growing body of knowledge about educational technology in many fields, there is limited information on the use of technology to support learning strategies, particularly in the area of grammar and within the context of Thailand. This significant gap has led to the necessity of conducting this research. In order to bridge the gaps, this research intends to study the effects of employing technology-based English grammar learning activities on students' use of GLS, achievement of English grammar, and their perceptions. The findings of this study can inform the development of lessons and learning activities that give students the opportunity to practice grammar learning through various technology-based activities. The results may also offer evidence to support educational policies that promote technology as an effective tool for teaching and learning. Our growing understanding of how to use technology to enhance the efficacy of learning English grammar can be beneficial for language education. It would open the door to more effective teaching strategies that promote active participation and foster a deeper understanding of grammar concepts through interactive and multimedia-rich learning experiences.

Research Objective

This study aims to examine the effects of using technology-based grammar instruction on 1) the use of English grammar learning strategies (GLS); 2) English grammar learning achievement; and 3) students' perceptions of technology-based grammar instruction. This study attempts to answer the following research questions:

1. How do technology-based English grammar learning activities affect students' use of GLS?
2. How do technology-based English grammar learning activities affect students' grammar achievement?
3. How do learners perceive technology-based grammar instruction?

Research Framework

This study used Pawlak's Grammar Learning Strategy Taxonomy Framework (Pawlak, 2013) to explain the strategies used by students. Pawlak has divided English GLS into 4 areas, namely: 1. metacognitive strategies (e.g., setting up a schedule to review grammar); 2. Cognitive strategies (e.g., discovering grammar rules by analyzing sample sentences); 3. Affective strategies (e.g., finding ways to relax when stressed); and 4. Social strategies (e.g., reviewing grammar with other students).

Methodology

Research participants

To answer the research questions, the researcher employed a quasi-experimental research design to collect data from two groups: an experimental group and a control group. The experimental group consisted of thirty-five First-Year English major students who received technology-based grammar instruction. The researcher served as the instructor for this group during the research period, which allowed direct access to the students, curriculum, and classroom dynamics. Meanwhile, the control group, which comprised thirty-four students from the same course, followed the traditional instruction without technology integration and the researcher was not their instructor. Although the control group did not receive the intervention, they remained a crucial part of the study for comparative analysis. Both groups enrolled in the course called "*English Usage for Communication 1.*" This course was compulsory for the First-Year students in the English major program. It aimed to provide students with knowledge of fundamental English grammar. In this course, various teaching methods were employed, including lectures, individual activities, group activities, paired activities, discussions, and technology-based learning activities, especially in the experimental group.

Variables

In this study, the independent variable (IV) was technology-based English grammar instruction. The dependent variables (DVs) included: (1) students' use of grammar learning strategies, (2) students' English grammar achievement, and (3) students' perceptions of learning grammar through technology-based instruction.

Research instruments

This study employed research instruments as follows:

1. The researcher used a pre- and post-test, consisting of thirty multiple-choice questions, to measure the students' grammar knowledge before and after learning technology-based English grammar learning activities. The test was aligned with the course's content and was piloted with fifteen non-sample students who had similar characteristics to the sample group. The researcher used SPSS to calculate the test's reliability (Cronbach's Alpha), resulting in a coefficient of 0.709, which is considered acceptable (Nunnally & Bernstein, 1994). This indicates sufficient reliability for the research.

2. The researcher adapted the Grammar Learning Strategies Inventory (GLSI) from Pawlak (2018) to assess the characteristics of GLS used by students. The GLSI, comprising 70 items, was divided into four strategies, as aforementioned. A 5-point rating scale was used to identify how frequently respondents used each strategy. The options ranged from very seldom, rarely, sometimes, often, and very often. The researcher used this set of

questionnaires in the earlier study (Jaruteerapan, 2022). It was subjected to a quality testing procedure, with a high internal consistency coefficient (Cronbach's alpha) of 0.82 (Pawlak, 2009). The researcher translated the questionnaire from English into Thai and evaluated the questionnaire's validity using the Index of Item Objective Congruence (IOC). Feedback from three experts was obtained to assess the content's alignment with the objectives, its relevance, and overall validity.

3. The researcher designed twelve grammar learning activities using various technologies to supplement teaching in the course. Each activity integrated technology to foster modern, engaging, and participatory learning experiences, allowing students to practice independently. The content was adapted from course materials and structured for basic grammar learning. Multimedia resources like quizzes in ClassPoint, interactive drills in TSU MOOC, and external videos were used to support active learning and student interaction. The activities were categorized into in-class interactive sessions and self-paced outside class practice. The researcher used the ASSURE model (Smaldino et al., 2014) to plan the technology-based activities, ensuring a systematic approach to teaching. It is important to note that this was the researcher's first time teaching these lessons. A full trial beforehand would have helped evaluate their potential success and identify possible issues.

Data collection

The data collection process includes the following steps:

1. Before the start of the course, the experimental and control groups conducted a pre-test to measure their initial knowledge of English grammar related to the course contents.

2. In addition to the pre-test, the experimental group also completed the pre-course survey called the Grammar Learning Strategies Inventory (GLSI), adapted from Pawlak (2018).

3. The experimental and control groups studied the course, which spanned 15 weeks. Each week, technology-based grammar learning activities were introduced as supplements to the experimental group. Technology was utilized as a tool to promote learning, including the use of computers, the internet, and applications in the learning process. On the other hand, the control group followed the course curriculum through traditional methods such as lectures and other supplementary activities, with no emphasis on the use of technology.

4. The experimental and control groups completed the post-test at the end of the course. The post-course GLSI survey was also administered with the experimental group.

5. Representatives from the experimental group were invited to participate in a focus-group interview through a questionnaire distributed at the beginning of the semester (the GLSI pre-course survey), with one question assessing their willingness to participate in the group interview later on. Ten students agreed to take part in the interviews. However, due to practical reasons, some students were unable to attend the interview on the actual day, resulting in a total of six participants.

Data analysis

Quantitative data was statistically analyzed using various measures such as frequency, percentage, means, and standard deviation. This included conducting a t-test to compare the scores of the experimental and control groups. Thematic analysis was employed to analyze qualitative data obtained from focus-group interviews with six students. The results and discussion are discussed below.

Results and Discussions

This section presents findings according to the research questions. Each of these findings is discussed in turn below.

1. How do technology-based English grammar learning activities affect students' use of GLS?

In response to the research question 1, the author presents findings from quantitative data deriving from the GLSI. Table 1 below illustrates the comparison of the mean scores of GLS used among the students in the experimental group before and after the course.

Table 1

A comparison of the mean scores of GLS used among the students before and after the course

No.	Strategy	Before instruction		Level of use	After instruction		Level of use
		M	SD		*M*	SD	
1	Metacognitive strategy	3.58	0.46	High	3.70	0.44	High
2	Cognitive strategy	3.51	0.37	High	3.61	0.34	High
3	Affective strategy	3.62	0.42	High	3.74	0.44	High
4	Social strategy	3.71	0.14	High	3.66	0.33	High
	Total	**3.60**	**0.38**	High	**3.68**	**0.35**	High

Note: N=35, 1.0-2.4 = low, 2.5- 3.4 = moderate, 3.5-5.0 = high

The findings from the GLSI survey show that the students used GLS extensively both before (*M*= 3.60) and after (*M* = 3.68) taking the course. Before the course, the students mainly utilized social and affective strategies (*M*= 3.71 and *M*= 3.62, respectively), with metacognitive and cognitive strategies following closely behind (*M* = 3.61 and 3.58, respectively). Similarly, after completing the course, the students continued to use GLS at a high level (*M* = 3.68). This suggests that they primarily relied on GLS throughout their learning. However, there were some differences in how they applied these strategies in terms of usage patterns. The students mainly employed affective and metacognitive strategies (*M* = 3.74 and *M* = 3.70, respectively), followed by social and cognitive strategies (*M* = 3.66 and *M* = 3.61, respectively). According to this finding, we can see that the students were more likely to use indirect techniques, such as affective strategies, that were employed to control their own feelings and motives when learning grammar. This finding also accords with the interview data from focus groups showing that activities using technology in the classroom encouraged the students to use affective strategies the most, which aligns with previous research findings (e.g., Ahmadi & Mahmoodi, 2012; Gunning, 2011; Jaruteerapan, 2022). A possible explanation may be due to the enjoyable and exciting learning experiences of playing the grammar quiz games and receiving rewards such as points or badges for answering correctly. By incorporating elements of gamification, it motivates and relaxes students during learning (Hong et al., 2022; Waluyo, 2023). As a result, students may approach grammar learning with a more positive mindset, as opposed to those who view it as a stressful or complicated activity. They, therefore, are more likely to engage deeply and stay active in their learning.

In summary, data from the GLSI shows that technology-based English grammar learning activities made no difference in the level of GLS used by students, both before and after learning. However, there were differences in the usage patterns of strategies. Nevertheless, these grammar learning activities had an impact on other aspects, namely grammar achievement, as will be discussed next.

2. How do technology-based English grammar learning activities affect students' grammar achievement?

This study includes two hypotheses as follows:

H0 (Null hypothesis): There is no difference in the post-test mean scores between the two groups, meaning the control group's mean score ($\mu 1$) is equal to the experimental group's mean score ($\mu 2$). (H0: $\mu 1 = \mu 2$)

H1 (Alternative hypothesis): There is a difference in the post-test mean scores between the two groups, meaning the control group's mean score ($\mu 1$) is not equal to the experimental group's mean score ($\mu 2$). (Ha: $\mu 1 \neq \mu 2$) Figure 1 below presents the mean scores of pre-and post-test of the two groups.

Figure 1

The mean pre-test and post-test scores between the control and experimental groups

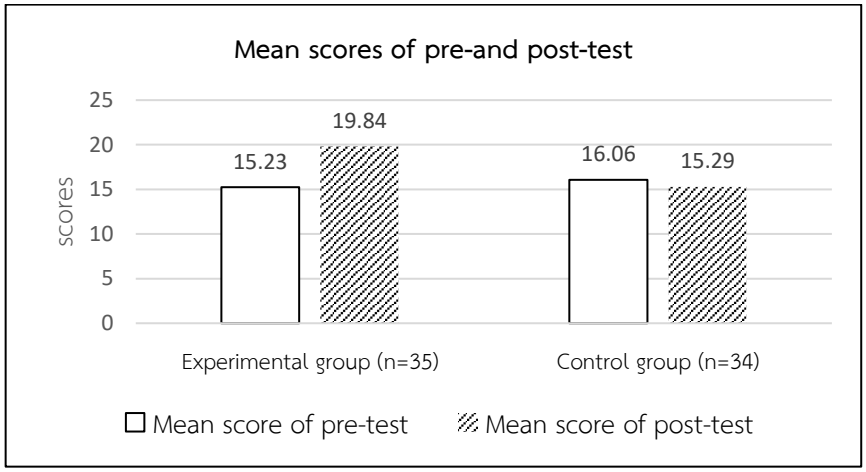


Table 2

Independent samples test

Independent Samples Test

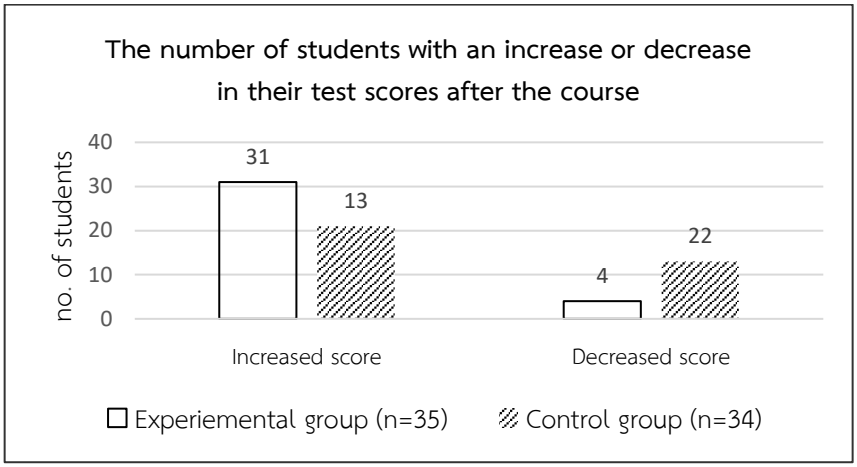
	Levene's Test for Equality of Variances		t-test for Equality of Means							
					Significance				95% Confidence Interval of the Difference	
	F	Sig.	T	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	7.336	.009	-4.423	68	<.001	<.001	-4.71429	1.06592	-6.84129	-2.58728
Equal variances not assumed			-4.423	60.040	<.001	<.001	-4.71429	1.06592	-6.84641	-2.58216

Note: P < 0.05

Figure 1 illustrates that the experimental group's post-test score increased from 15.23 to 19.84 points (an increase of 4.51 points), while the mean score of the post-test of the control group decreased slightly from 16.06 to 15.29 points (a decrease of 0.77 points). Additionally, the t-test analysis results presented in Table 2 show that there is a statistically significant difference in post-test scores between the experimental and control groups. Since the two-sided p-value < .001, which is much lower than the significance level of 0.05, we reject the null hypothesis (H0). Furthermore, the negative mean difference (-4.71429) indicates that the control group's mean score is lower than the experimental group's mean score. These results suggest that technology-based English grammar learning activities, as an intervention applied to the experimental group, had a significant effect on improving students' grammar achievement compared to the control group.

Figure 2

The number of students with an increase or decrease in their test scores



Moreover, if we consider the data in Figure 2, thirty-one out of thirty-five students in the experimental group had increased post-test scores. This accounts for 88.57 percent, which indicates a positive trend as it demonstrates the development of knowledge and skills among students in this group. Meanwhile, the number of students in the control group with post-test scores increased by thirteen out of a total of thirty-four students, accounting for 38.24 percent.

The data also reveals that the number of the control group's students whose scores decreased in the post-test was more than half, 61.76 percent. These data indicate the difference in post-test scores between the control and the experimental groups, which employed different teaching methods. It may be inferred that there was more improvement in the knowledge and skills of the students in the experimental group than in the control group after the experiment. The researcher assumes that the increase in scores in the experimental group may be due to the use of technology to improve and strengthen students' learning processes in many aspects. For example, employing technology can create a learning environment that provides students with a variety of learning situations and greater flexibility. The use of technology can make learning possible at all times, as it enables them to access information conveniently and choose the most appropriate practice time. It fosters a learning context that connects learning and the daily lives of students. Therefore, they are more interested in and committed to studying English grammar. As a result, there may be an increase in the students' grammar achievement. In addition, when learners in the experimental group receive learning experiences that are more diverse and responsive to the specific interests and needs, their learning may become more effective.

There is evidence from research supporting the notion that successful test takers tend to have a consistent and diverse mix of learning styles. This is because learners are often open to new and diverse learning options to maximize their learning experience (Griffiths & Soruç, 2020). Furthermore, past research has reported that educational activities that used technologically gamified tools have been recognized as supporting knowledge, skills, and the use of automatic learning strategies (Da-Oh et al., 2023; Proske et al., 2014).

To conclude, the positive outcome resulting from the use of technology leads the researcher to conclude that technology-based grammar learning activities had an impact on students' grammar achievement.

3. How do students perceive technology-based grammar instruction?

In response to research question 3, the author provides conclusions from qualitative data derived from focus-group interviews, as shown in Table 2 below.

Table 3

Perceptions of technology-based grammar learning activities

Perception	Description
Positive perception	A. Interesting and engaging
	B. Motivation and stimulation
	C. Flexibility and accessibility
	D. Diverse learning situations
Negative perception	E. Equipment readiness
	F. Internet access
	G. Classroom environment

Note: N=6

The research findings from the focus group data show that six research participants have both positive and negative perceptions of the use of technology in learning, as summarized in Table 3. Students understand that utilizing technology as a tool for English grammar learning has both advantages and disadvantages. Positive perceptions reflect understanding and acceptance of the benefits of technology in learning. Students provided positive descriptions of using technology as a learning tool such as making learning interesting and engaging *(A. Interesting and engaging)* and creating motivation and stimulation for learning *(B. Motivation and stimulation).* This is because games that require students to answer questions correctly to pass levels, give rewards, or accumulated points are very motivating for learning. As Student A stated,

> *"I think it's really good. When we do activities together, it's fun. If everyone does it individually in the textbook, it's kind of boring. But when we answer the quiz game on the website, we feel excited. Everyone wants to get more points, especially when there is a competition to collect points like this (Quizizz). We can see who gets how many points, who is in first place, and who is in second place. It's fun. Sometimes, when I'm kind of zoning out in the class, doing something fun like this might bring my focus back*."

In addition, the researcher also found that interesting and engaging activities can lead students to follow up with subsequent materials or activities. They help stimulate the motivation of the learners to participate in learning. Student D mentioned that:

> *"Previously, I used to focus more on reading books and the materials that the teachers distributed, than anything else. But when I saw various quiz practice platforms on the internet that were used in the classroom, they were fun, and I started wanting to do the exercises myself more. It's not like the old way of learning, which used only books. Sometimes I try looking at the online exercises. There are so many of them, so it's very convenient to choose from*."

When learners are motivated and find interest in the learning process, they are more likely to create learning experiences that are meaningful and important to them. Engaging students with interesting and challenging activities can boost their motivation to participate, inspire them to learn more, and create learning experiences that they will remember. Therefore, by fostering motivation and stimulation, educators can encourage active involvement or engagement, which is a key outcome of utilizing technology in education, according to Kolb (2011). This aligns with recommendations from a number of studies that advised teachers to use technology to motivate students (Alizadeh, 2016; Al Kaboody, 2013; Deldeniya, Khatibi, & Asam, 2018; Mahmoudi, 2020; Vu et al., 2023). Another aspect emerging from the interview data involves flexibility and accessibility (*C. Flexibility and accessibility*). Utilizing technology to learn English grammar not only gives learners flexibility and convenient access

to learning resources, but it also helps them integrate grammar learning into their everyday lives, as mentioned by Student F.

> *"I find it convenient when teachers assign supplementary exercises on Mooc because I can do them anywhere and anytime. Just using a mobile phone is enough. Sometimes, I even do it while having a meal at the cafeteria."*

Similarly, Students A and B expressed their thoughts in a way suggesting that their learning preferences can be supported by flexible technology-based activities. Student B specified that,

> *"Actually, I don't really like doing exercises in the class that much. Sometimes, I feel like I need a break because the lessons can be quite long. So, I prefer doing it in my dormitory. Once I'm not tired anymore, I'll do it. When I'm finished, I can just press send in the system."*

However, Student A pointed out that

> *"... but for me, I usually hand in my work right after class because I'm afraid I might forget. It depends whether the task is assigned individually or in groups. If it's a group task, we usually work together under the building."*

It can be said that technology transforms learning from a mere classroom activity into an essential part of daily life. This finding is in line with Vu et al.'s (2023) study, indicating that the student also perceived the flexibility afforded by a mobile application. By using mobile applications, they can learn whenever and wherever they want without having to be in a classroom. According to Hyler and Hicks (2017), one notable feature of using technology in learning is that learners can work on assignments anytime and anywhere they have access to technology, meaning that learning is not limited to only the classroom. This may lead to additional training outside of class hours or during regular school hours. Many theorists agree that increasing the quantity and quality of students' L2 input is essential to the success of SLA (Blake, 2008). Thus, if teachers are able to integrate technology into the work that students complete outside of class, they can create more opportunities for students to interact with the target language. It helps increase the amount of L2 input they are exposed to. This is an important factor in promoting the continuous application of learning grammar strategies in students' daily lives.

Consequently, combining everyday grammar learning with technology helps create a variety of learning situations *(D. Diverse learning situations).* The data from the focus groups shows that students were aware of the integration of technology in grammar learning as creating a variety of learning situations. As stated in the interview, *"It's more fun when we study in different ways* (Student F)," or *"I enjoy watching videos and various media because it's diverse. I can understand better* (Student C)." Students perceived the use of technology in learning as a very useful tool for promoting an engaging and effective learning process.

However, there were also negative perceptions arising from experiences or expectations that were not met. Some students perceived that using technology in their studies made learning more difficult. This is because sometimes there could be technical or emotional issues associated with technology use that affected student learning. Data from focus groups shows that students were aware of problems from the unavailability of devices used in learning activities *(E. Equipment readiness*), such as computers, tablets, laptops, or mobile phones. Some students were not able to participate in activities or engage in activities to their fullest extent due to a lack of adequate equipment preparation.

As mentioned in the interview, "*One day my mobile phone had a problem. I tried to open the app, but it froze. So, I couldn't get into ClassPoint. I had to ask a friend next to me to see it* (Student B)." or *"When I tried to do the exercises in the Mooc, sometimes it couldn't be dragged (the drag and drop activities where students drag text boxes into the correct spaces). I don't know if other people have this problem. But my mobile phone screen is small. The options are at the bottom, so dragging them up to fill in the blanks is difficult and time-consuming* (Student A)." Moreover, learners identified problems related to internet access that prevented them from fully participating in activities that required online connections *(F. Internet access).* For example, Student F

said that, "*The university internet is very slow, especially in the SC building. When I'm in the middle of online quizzes, it suddenly disconnects, and I have to log in and out many times. I can't keep up with my friends*." And Student E mentioned, "*Sending work or doing assignments in Mooc is good, but there is a downside that if many people send it at the same time, it tends to slow down*." Unreliable internet access that prevents students from accessing necessary information or learning tools can lead to disappointment and feelings of uncertainty. In addition, inappropriate or uncomfortable classroom conditions may make students feel unprepared or mentally unwell for learning. *(G. Classroom environment).* These issues are significant factors influencing students' learning processes. Therefore, to maximize the effectiveness of using technology as a learning tool, teachers should address and create suitable learning environments for students appropriately and efficiently.

Conclusion

The results of this study help us understand that, despite not having a substantial impact on students' use of GLS, integrating technology into learning influenced their usage patterns in different aspects directly. Moreover, we can observe the improvement in their grammar achievement as well as their positive perceptions about the application of technology in teaching and learning. This indicates the efficacy of using technology to support students' English grammar achievement. As a result, this study confirms previous research reporting the positive impact of using technology in language education (Aladini et al., 2022; Bikowski, 2018; Cam & Tran, 2017; Hashim et al., 2019; Refat et al., 2020; Saeedi & Biri, 2016; Summerhays, 2020; Vu et al., 2023). But it's crucial to remember that there isn't just one technology that works best for studying languages. As Blake (2008, p.131) suggests, "... all available tools have a proper place given a felicitous set of learning conditions created by the teacher, supported by the learning environment, and accepted by the learners." Thus, successful technology integration depends on the specific circumstances in which it is applied.

Limitations of the study

This study has several limitations which should be acknowledged. One key limitation involves controlling extraneous variables, as the control group was taught by a different instructor, leading to potential differences in teaching methods. However, it should be noted that the study's design intentionally introduced a key difference between the two groups: the experimental group engaged in technology-based learning activities, while the control group received traditional instruction. While this difference is the core intervention, it also introduces an extraneous variable, as factors such as students' familiarity with technology, motivation, and prior grammar knowledge may have influenced the outcomes. However, to minimize potential confounding effects, standardized lesson plans, textbook, and assessment criteria were applied consistently across both groups. This can suggest comparable baseline proficiency between the groups and make them suitable for comparison. Another limitation is the sample size, which may not be large enough to generalize the findings to a broader population. Additionally, the duration of the research may have been insufficient to observe long-term effects or outcomes.

Recommendations

1. Implication of the study

Conclusions from this research can inform those involved, such as teachers, teacher trainers, or program administers, who play an important role in ensuring that technology is employed effectively to the benefit of students in English language programs (Santos et al. 2018). Teachers can develop new teaching activities that emphasize the use of technology to enhance learning and the efficiency of students' use of GLS. Undeniably, students nowadays grow up with technology and live in an environment where technology is an integral part of their daily lives (Hyler & Hicks, 2017). They are more open and tend to prefer learning through electronic devices (Wang & Smith, 2013). Thus, in this digital age, teachers can find many ways to immerse students in English-language contexts in their daily lives. For example, they can create online learning resources or applications that help students continuously practice grammar skills, such as teaching videos, interactive exercises, or online

quizzes. When learners can access and practice skills anywhere and anytime, it makes learning more convenient and flexible. Previous research has shown that teachers and students benefit greatly from various language learning resources on websites to enhance their learning experiences (Yesilel & Basak, 2016). Using technology in teaching, however, is not an easy task for every teacher. A significant problem is that many teachers lack confidence and skills in utilizing technology (Moeller & Reitzes, 2011). Also, each teacher's knowledge and expertise in technology application may vary (Blake, 2008). Therefore, providing guidance and support to teachers when using technology for teaching is crucial. Teachers at all levels need to be supported in using technology appropriately according to their level of knowledge and expertise (Blake, 2008; Hyler & Hicks, 2017; Marsaulina, 2020). As Torsani (2016) puts it, the development of instructional technology in language teacher education is a dynamic phenomenon that is always changing quickly. Teachers need to be adaptable enough to changes in the field, particularly when it comes to instructional methods, tools and resources. This is to ensure that their lessons are productive, efficient and appropriate for students in an era where technology plays an increasingly important role in learning and teaching.

2. Recommendations for future research

Future research may focus on how to enhance teachers' confidence and skills in utilizing technology for teaching. This may involve exploring approaches to guide and support teachers in using technology appropriately in their teaching practices. Furthermore, more in-depth studies on affordances and constraints that affect students' use of technology in learning would be beneficial.

Understanding how environments and social situations affect learning may help teachers design a better learning experience that is engaging and relevant to students' learning styles and preferences. These investigations will help to advance the practice of technology integration in education and contribute to the development of more effective and student-centered teaching methodologies.

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