Arab World English Journal
INTERNATIONAL PEER REVIEWED JOURNAL ISSN: 2229-9327

Arab World English Journal (AWEJ) Special Issue on CALL Vol. 17, No.12. July 2026 Pp.379-399
DOI: https://dx.doi.org/10.24093/awej/call12.22

Examining the Implementation of the SAMR Model in EFL Classes at Saudi Secondary Schools: A Mixed-Methods Study

Jawza Alshammari
English Language Department,
College of Arts and Literature, University of Hail, Hail Saudi Arabia
Email: jh.alshammari@uoh.edu.sa

Received: 03/27/2026 Accepted:06/29/2026 Published:07/15/2026

Abstract

The role of information and communication technology (ICT) in education has evolved from being a basic tool to a transformative agent of learning, largely due to its rapid advancement. This is especially true in the context of teaching English as a foreign language (EFL), where digital tools can significantly improve learning outcomes and student engagement. However, the challenge remains in effectively integrating ICT to enhance rather than replace traditional methods. This study examines the implementation of the substitution, augmentation, modification, and redefinition (SAMR model) in EFL classes at secondary schools in Saudi Arabia. Using an explanatory mixed-methods approach, the study examines how educators apply the SAMR framework in this context. Data collection involves the use of surveys and interviews with female teachers to gather insights into their experiences and perceptions regarding the integration of ICT in EFL instruction. The study aims to understand the extent and nature of the SAMR model application and its implications for EFL teaching practices in Saudi secondary education. The significance of this study lies in providing insights into ICT integration practices to enhance digital EFL instruction in Saudi Arabia. The results show that ICT is primarily used as a substitute, with minimal at the other three higher levels. Inadequate infrastructure, limited access to devices, and excessive teaching workloads are the primary barriers to the effective use of higher-level ICT. The study recommends improving technological infrastructure, increasing access to digital resources, and supporting more effective implementation of higher levels of the SAMR model.

Keywords: Digital learning, English as a foreign language instruction, information and communication technology integration, mixed-methods research, Saudi Arabia, SAMR model, secondary education, technology in EFL

Cite as: Alshammari, J. (2026). Examining the Implementation of the SAMR Model in EFL Classes at Saudi Secondary Schools: A Mixed-Methods Study. *Arab World English Journal (AWEJ) Special Issue on CALLVol.17.* (12)379-399. https://dx.doi.org/10.24093/awej/call12.22

Introduction

Information and communication technology (ICT) is regarded as one of the most developed tools in the 21st century for education. It impacts the fundamentals of education, as it facilitates the connection between students and teachers and encourages students to interact with their teachers positively (Zakaria et al., 2025). In addition, ICT promotes togetherness through digital connections among teachers and students (Huang et al., 2023). In the 21st century, ICT is ubiquitous, and teachers must incorporate appropriate tools into their lesson plans to meet the needs of stakeholders and stay current with developments in the education field (Al Hajri et al., 2025; Calamlam, (2020). In the current globalized period, rapid technological developments have had a significant impact on education. Teachers have innovative opportunities to provide more dynamic and varied material using ICT in their classes. Additionally, it provides students with opportunities to acquire knowledge in more effective ways, enhancing their learning and engagement and enabling them to achieve their goals. However, obstacles, including inadequate training, insufficient funding, and resistance to change, can complicate implementation (Kopcha et al., 2023).

Due to the rapid development of ICT, digital tools and applications have become a significant component of contemporary language instruction. Motivating and engaging learning experiences are also made possible by these tools and applications (Kumi-Yeboah, 2020). Teaching EFL to students who were born as digital natives requires teachers to include ICT in their language instruction. Information and communication technology facilitates learning for students, improves their proficiency in foreign languages, and enhances the productivity of learning environments (Xodabande, 2018). Additionally, it supports EFL teachers in implementing more interactive and realistic teaching methods and overcoming obstacles when implementing these teaching techniques. For example, educational applications, interactive videos, and artificial intelligence (AI)-based educational programsees can be used, which enable students to interact with the language naturally and interactively (Ali, 2024; Alshammari, 2024). The use of ICT can also help students become more proficient in EFL speaking, listening, reading, and writing (Hembrough & Jordan, 2020). According to research findings, students who engaged with technologically advanced classrooms demonstrated a notable improvement in speaking abilities as well as in all other language components, particularly in vocabulary, grammar, and pronunciation (Golonaka, 2014; Shadiev & Yang, 2020). Each student can learn at their own pace thanks to ICT, which helps customize the educational process to meet their needs. Moreover, the overall quality of English language instruction is significantly improved when EFL teachers successfully integrate ICT. This, in turn, creates more dynamic, student-centered, and linguistically rich learning environments that promote increased engagement, language proficiency, and pedagogical innovation (Nazim, 2024).

Recent years have witnessed significant advancements in ICT, accompanied by the emergence of various theories and models, such as the SAMR model, to understand the impact of ICT on education. The SAMR model, developed by Puentedura (2006), provides a framework for evaluating instructors and integrating digital ICT in education (Bicalho et al., 2023). The model helps teachers advance through a variety of transformative behaviors by offering a methodical approach to integrating ICT into the classroom (Puentedura, 2006), thereby enhancing teaching experiences.

According to Mishra and Kohler (2006), educators must acquire strong pedagogical skills and in-depth subject knowledge to help their students gain a thorough understanding of ICT and

the skills necessary to thrive in the 21st century. The purpose of this study is to investigate the application of the SAMR model in EFL classrooms in secondary schools in Hail City, Saudi Arabia. It also seeks to identify the obstacles that prevent teachers from using ICT at higher levels. This study identifies the technological practices of teachers and barriers that prevent them from effectively utilizing ICT through questionnaires and interviews with EFL secondary school teachers. This study aims to identify the key elements that contribute to the success of ICT in education and to generate ideas for creating more effective learning environments.

Literature Review

Puentedura (2006) established the SAMR model, which divides ICT integration into four stages: substitution, augmentation, modification, and redefinition. Each level represents a distinct degree of technological integration and its corresponding impact on teaching methods.

The utilization of various educational technologies is mapped hierarchically against the levels or stages of development using the SAMR descriptive framework (Leary et al., 2021). Teachers and school educators have embraced this model as a practical tool to track the advancement of ICT development as they strive towards what is perceived as the ideological stance of using ICT to redefine curriculum. According to Puentedura (2013), the SAMR model suggests that more substantial educational advancements may result from greater degrees of ICT integration, such as modification and redefinition. It also implicitly assumes that greater student achievement will result from a higher level of integration (Zhaı et al., 2018).

At the first level, *substitution*, teachers can readily employ ICT as a replacement for more conventional methods, as they use it daily (Kelsch & Wang, 2021). At this level, tasks can be completed without ICT. There are just minor variations in how pupils are taught the material; there are no significant differences in the content itself. For instance, teachers can easily create assignments in the form of PDF or Microsoft files and share them with their students on Google Drive or Microsoft OneDrive. They can also shoot videos and transmit them to their students to view on Learning Management Systems (LMSs).

The second level, *augmentation*, "is where technology substitutes for traditional teaching methods, but with functional improvements" (Son, 2024, p. 3). Although the content remains unchanged, students can now benefit from digital features to make the class more engaging (Hamilton et al., 2016). Multimedia presentations and digital portfolios, for instance, can be created, providing them with additional ways to demonstrate their understanding of the material. Teachers can administer tests using Socrative and Kahoot tools to ensure proper distribution. Using an app like Padlet, educators can also construct virtual bulletin boards on which students can post questions, links, and images (Bui, 2022).

At the third level, *modification*, educators may think about utilizing LMSs, such as the Madrasati learning platform, established by the Saudi Ministry of Education, to manage the administrative aspects of classroom administration, including publishing assignments, keeping track of grades, texting students, and making a schedule. Online education creates new avenues for communication, many of which can benefit historically underserved students (Cui & Coleman, 2021). For instance, studies reveal that female students are less attentive in class (Zarraonandía, 2019); therefore, backchannels—alternative discussions that may accompany instruction—that promote participation may be beneficial to them. In the meantime, students can write their queries into Zoom's text chat feature, which can help students overcome their shyness if there are dozens of them on the call (Hashim, Matraf & Hussain, 2021). Slower-paced asynchronous conversations,

such as those in an email thread or online forum, may also be beneficial for students who prefer to collect their thoughts.

At the fourth level, *redefinition*, learning is fundamentally transformed. Digital technology enables new activities that were previously inconceivable, such as the usage of LMSs that allow students to create content for public access (Levy-Nadav et al., 2026). For instance, virtual groups can now communicate with people around the world, including experts in specific fields. After reading a book, students may even have the opportunity to join an online session with the author to ask questions (Wang, 2021). At this highest level, ICT also enables students to virtually bring audiences into digital classrooms (Abdelhalim, 2025). They can also publish their work on their own blogs or wikis, which they can share with the public and comment on. Some LMSs can even link distant classrooms, allowing students to write and respond.

The SAMR framework encourages teachers to do more than use ICT as a replacement for conventional teaching techniques. Using the SAMR model, educators can critically evaluate how their use of ICT affects students' learning and work to develop more powerful and interesting classes (Bicalho et al., 2023). The ultimate objective is to create educational opportunities that encourage deeper comprehension and active student participation, in addition to integrating ICT successfully. However, despite the increasing interest in the SAMR framework, there remains limited research examining its implementation in Saudi secondary EFL classrooms. This study addresses this gap by investigating how EFL teachers apply the SAMR model and perceive its use in their instructional practices. Figure 1 illustrates the levels of the SAMR model.

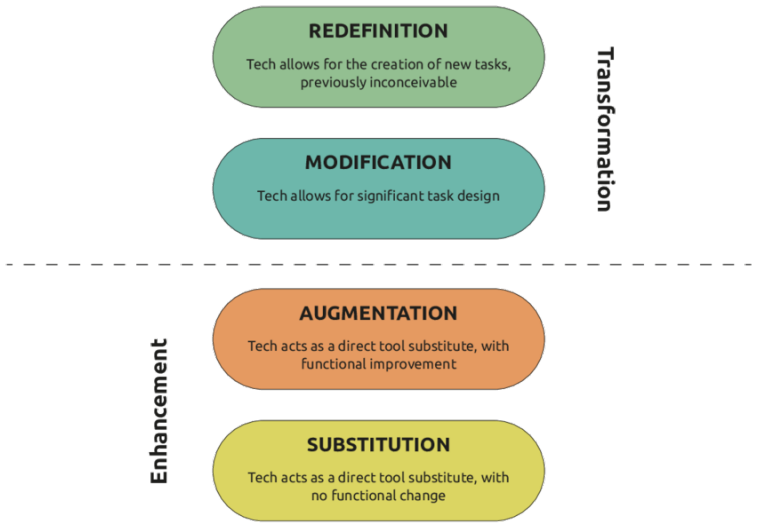


Figure 1. The SAMR model (Adapted from Puentedura 2014)

Methodology

Data Collection

The primary premise of a mixed-methods approach is that a better understanding of research problems can be achieved by combining different methods, rather than relying solely on a single approach (Creswell & Clark, 2017). This study employs a sequential explanatory mixed-methods design, comprising quantitative and qualitative phases, to provide a more comprehensive understanding of how ICT practitioners use technological tools, their activities, and their perspectives on the issue (Creswell, 2024; Shannon-Baker, 2016). Additionally, integrating

quantitative and qualitative data enables comparison, evaluation, and clarification of differences in the results (Morgan, 2007).

The study involves EFL teachers from randomly selected secondary schools in Saudi Arabia. Participants were chosen through purposive sampling to ensure they have experience with ICT integration in their EFL teaching practices. The first phase of the study involved distributing an online questionnaire to female teachers. A total of 89 EFL teachers responded. The questionnaire, derived from Buledi and Badaria (2024), contained 32 elements related to the four usage levels of SAMR and focused on assessing teachers' use of ICT based on these levels. The data collected were analyzed using descriptive statistics.

Since in-depth data cannot be easily obtained through quantitative aspects (Abraham & Padmakumari, 2026), the second phase involved conducting six individual interviews with selected EFL teachers to explore further their views on ICT use and their ability to achieve various levels of the SAMR model. The interviews aimed to provide a deeper understanding of the factors influencing teachers' use of ICT and how they perceive their ability to implement the SAMR framework in their teaching practices.

Data Analysis

A structured questionnaire was developed to gather quantitative data on teachers' perceptions of the SAMR model. The data were analyzed using the Statistical Package for Social Sciences (SPSS) version 29 programme. Firstly, descriptive statistics, such as frequencies, percentages, means, and standard deviations presented as (Mean ± SD), were used to describe the basic features of the data. Reliability was assessed using Cronbach's Alpha, with values ranging from 0.941 to 0.972 across the four dimensions, indicating strong internal consistency and scale reliability ($\alpha = 0.969$ overall). Secondly, normality tests were conducted using Kolmogorov-Smirnov and Shapiro-Wilk tests for the study variables. Subsequently, inferential statistics were used to test the differences between groups in the study. An independent samples t-test was used for comparisons between the two groups (Bachelor vs. Master and Urban vs. Rural), and an ANOVA was used for comparisons between the three teaching experience groups.

Six semi-structured interviews were conducted with a subset of teachers to gain qualitative insights into their experiences and views on the SAMR model. The interviews focused on the practical application of the model, perceived impact on teaching, and obstacles faced. The interview data were analyzed using the hybrid approach of deductive and inductive analysis, following the approach outlined by Fereday and Muir-Cochrane (2006). To facilitate an organised and methodical coding procedure, the data were first categorized according to a pre-existing theoretical framework based on the SAMR model levels deductively. Following this, inductive analysis was employed to to extract themes and patterns from the data directly. The goal of combining the two methods is to achieve a balance between the depth of field data and theoretical rigor.

Ethical approval was obtained from the University of Hail (Approval Number: H-2024-457). The study adhered to ethical guidelines, ensuring the privacy and confidentiality of all participants. Teachers were informed about the purpose of the study and provided with consent forms prior to participation. To protect the anonymity of the participants, pseudonyms were assigned to each participant during the data analysis and reporting stages. Furthermore, all collected data were stored securely, and no personally identifiable information was disclosed.

Results

Quantitative Results

The descriptive analysis provides information on the basic characteristics of the data, including descriptive statistics such as frequency and percentage. It also provides a measure of central tendency (mean) and a measure of dispersion (standard deviation). All items are coded from one (Never) to five (Always). The mean score intervals are classified as follows: very low (1.00 to < 1.80), low (1.80 to < 2.60), medium (2.60 to < 3.40), high (3.40 to < 4.20), and very high (4.20 to < 5.00).

Table 1 presents the detailed demographic characteristics of teachers participating in a study on ICT usage in English teaching.

Table 1. *Demographic characteristics of teachers (n = 89)*

		n	%
Number of years of Experience	1-5 years	37	41.6
	6-15 years	24	27.0
	16-25 years	17	19.1
	More than 25 years	11	12.4
Academic qualification	Bachelor	65	73.0
	Master	24	27.0
School location	Urban	56	62.9
	Rural	33	37.1

Descriptive Results

As shown in Table 2, substitution has the highest mean score (4.17 ± 1.187) and ranks first, indicating that teachers are most likely to use ICT to replace traditional teaching methods. This is followed by augmentation, which ranks second with a mean of 3.29 ± 1.137. Modification ranks third with a mean of 2.37 ± 1.156. Redefinition is the least common level, ranking fourth, with a mean score of 1.90 ± 1.138.

Table 2. *Teachers' usage of ICT for SAMR levels (n = 89)*

Items	*Mean*	*Std. Deviation*	*Level*	*Rank*
S1. I use the Smartboard instead of the traditional whiteboard	4.22	1.321	Very High	3
S2. I use the textbook in softcopy rather than hardcopy	4.27	1.250	Very High	2
S3. I use the projector to display information or notes	4.31	1.230	Very High	1
S4. I conduct listening activities on students' smartphones	4.13	1.299	High	5
S5. I use Madrasati to assign homework	4.21	1.286	Very High	4
S6. I use WhatsApp/Telegram groups for course updates	4.08	1.333	High	7
S7. I use Madrasati instead of workbooks for review exercises	4.06	1.393	High	8

S8. I use PowerPoint for whole-class instruction	4.09	1.285	High	6
A1. I give class feedback via Madrasati	3.71	1.342	High	1
A2. I create video lessons and share them on class WhatsApp	3.54	1.340	High	2
A3. I use MS Word features like track changes to highlight writing errors	3.30	1.369	Medium	4
A4. I add hyperlinks to homework assignments for more information	3.40	1.369	High	3
A5. I employ gamification apps (e.g., Kahoot & Quizizz) for language practice and assessment	3.29	1.300	Medium	5
A6. I use translation apps (e.g., Google Translate) to help students understand words and phrases	3.12	1.397	Medium	6
A7. I use Web 2.0 tools (e.g., Quizlet) to teach vocabulary	3.04	1.356	Medium	7
A8. I record feedback on students' work and share it online	2.94	1.343	Medium	8
M1. I hyperlink resources as feedback to students to encourage further learning	2.75	1.367	Medium	1
M2. I ask students to create video snippets and share them online	2.58	1.338	Low	2
M3. I ask students to use videos and images to enhance their written tasks	2.51	1.324	Low	3
M4. I ask students to write and share various pieces online	2.31	1.284	Low	5
M5. I use interactive navigation apps (e.g., Google Earth or Waze) to practice language items	2.46	1.349	Low	4
M6. I ask students to write and comment on poems and stories online (e.g., using Storybird)	2.17	1.218	Low	6
M7. I use digital platforms on students' smartphones to teach language skills	2.08	1.227	Low	8
M8. I use cloud tools (e.g., Google Docs, Padlet, or Pinterest) to conduct collaborative learning activities	2.10	1.244	Low	7
R1. I ask students to synthesize their analytical thoughts using multimedia tools	2.09	1.302	Low	1
R2. I require students to create short collaborative documentaries using multimedia tools	1.89	1.182	Low	4

R3. I require students to read online materials and annotate difficult words	1.96	1.251	Low	3
R4. I require students to screencast content explanations and share it for collaborative feedback	1.87	1.236	Low	5
R5. I ask students to express their ideas online and collaborate with other classmates for feedback	1.82	1.230	Low	6
R6. I use online apps (e.g., Prezi, Nearpod, Canvas) to create and share hyperlinked presentations	1.81	1.160	Low	7
R7. I use social media to give updates, share materials, and provide feedback	1.97	1.327	Low	2
R8. I record students' presentations and comment on it online as feedback	1.80	1.257	Low	8
Substitution	4.17	1.187	High	(1)
Augmentation	3.29	1.137	Medium	(2)
Modification	2.37	1.156	Low	(3)
Redefinition	1.90	1.138	Low	(4)

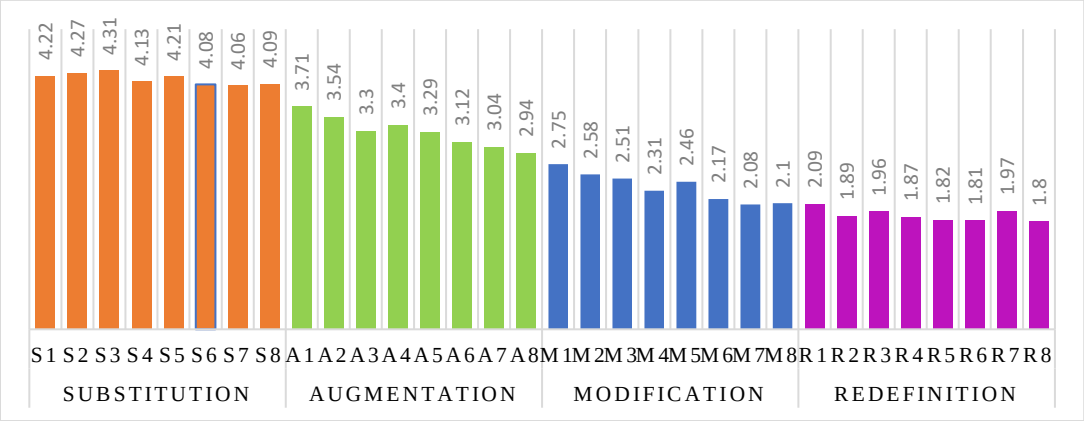


Figure 2. Visual comparison of items across SAMR levels

As shown in Figure 2, usage was generally higher in the substitution dimension, followed by the augmentation dimension. In contrast, usage patterns in the other two dimensions did not exhibit apparent differences. English teachers' ICT usage patterns appeared similar across the modification and redefinition levels, both of which scored poorly. Augmentation scored slightly higher, falling within the medium range. Further visual inspection of the item means suggests that ICT use in English teaching occurred mainly at the basic levels (i.e., substitution and augmentation).

Substitution

Figure 3 presents the descriptive statistics of ICT substitution in teaching English. The highest-ranked item was the use of projectors to display information or notes, with a mean score

of 4.31 ±1.230. This was followed by using soft-copy textbooks instead of hard-copy versions (4.27 ± 1.250) and then using a smartboard instead of the traditional whiteboard (4.22 ± 1.321). The last rank was for using *Madrasati* instead of workbooks for review exercises, based on the lowest mean score (4.06 ± 1.393). On average, teachers substituted traditional teaching methods with ICT, with an overall mean score (4.17 ± 1.187), which is considered a high level.

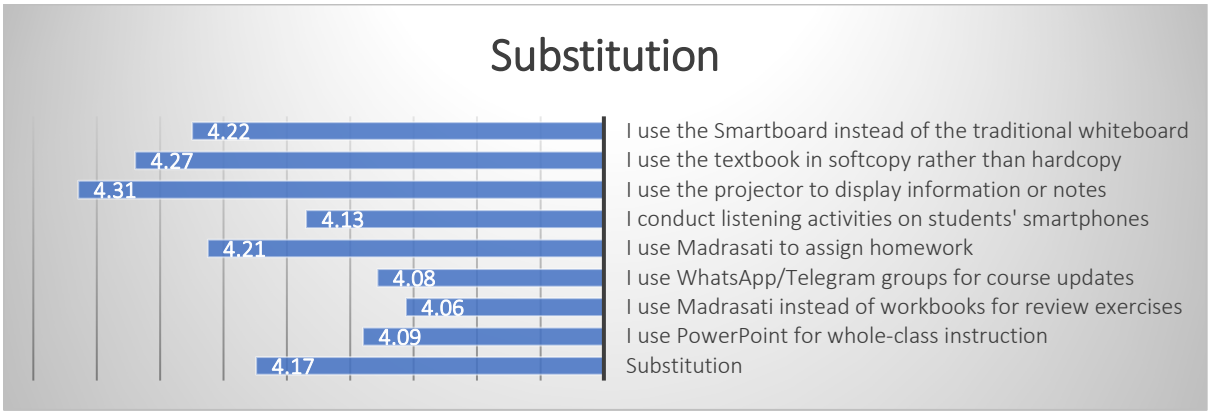


Figure 3. Visual comparison of items across the Substitute level

Augmentation

Figure 4 presents the descriptive statistics of teachers' responses regarding the augmentation of ICT use in teaching English. The highest-ranked item was providing class feedback via *Madrasati*, with a mean score of 3.71 ± 1.342. This was followed by creating video lessons and sharing them on class WhatsApp, with a mean score of 3.54 ± 1.340, and then adding hyperlinks to homework assignments for more information (3.40 ± 1.369). The lowest-ranked item was recording feedback on students' work and sharing it online, with a mean score of 2.94 ± 1.343. On average, teachers' augmentation of ICT in teaching English has an overall mean score of 3.29 ± 1.137, which is considered a medium level.

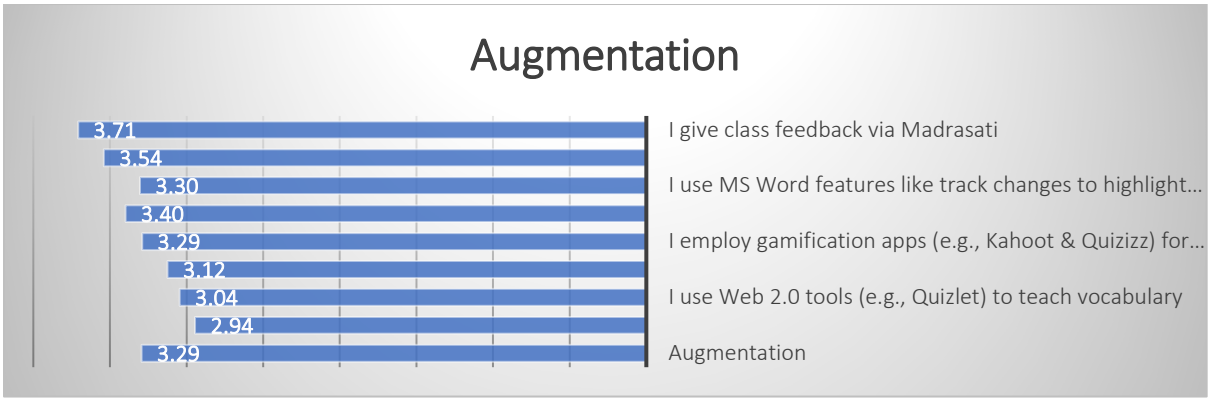


Figure 4. Visual comparison of items across the Augmentation level

Modification

Figure 5 presents the descriptive statistics of teachers' responses regarding the use of ICT modification in teaching English. The highest-ranked item was hyperlinking resources as

feedback to students to encourage further learning, with a mean score of 2.75 ± 1.367. This was followed by asking students to create video snippets and share them online (2.58 ± 1.338), and then to use videos and images to enhance their written tasks (2.51 ± 1.324). The lowest-ranked item was the use of digital platforms on students' smartphones to teach language skills (2.08 ± 1.227). On average, teachers use ICT modification in teaching English to a low degree, with an overall mean score of 2.37 ± 1.156.

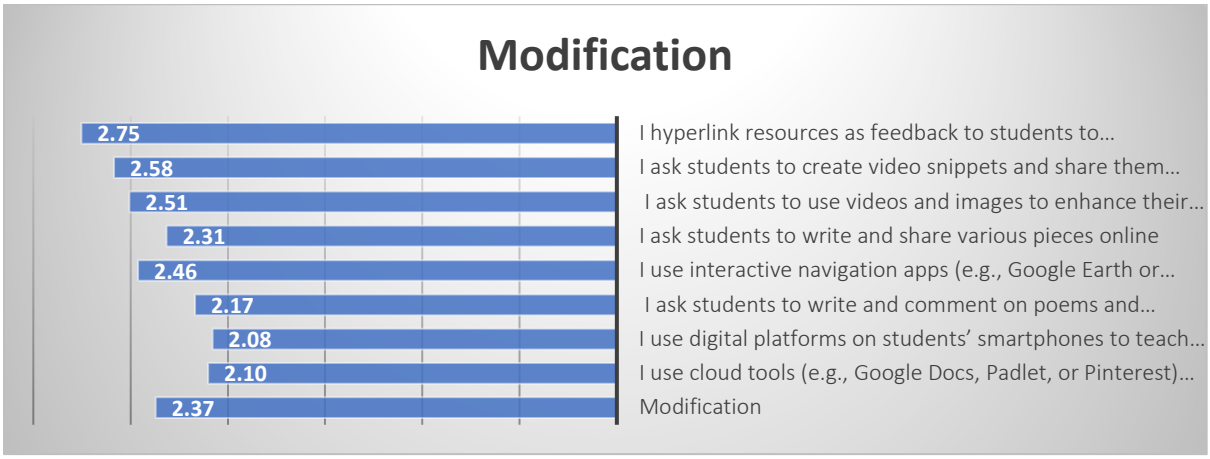


Figure 5. Visual comparison of items across the Modification level

Redefinition

Figure 6 displays the descriptive statistics of teachers' responses regarding ICT use in teaching English at the redefinition level. The highest-ranked item was asking students to synthesize their analytical thoughts using multimedia tools, with a mean score of 2.09 ± 1.302. This was followed by using social media to give updates, share materials, and provide feedback (1.97 ± 1.327), and then requiring students to read online materials and annotate difficult words (1.96 ± 1.251). The lowest-ranked item was recording students' presentations and providing feedback online (1.80 ± 1.257). On average, teachers demonstrated a low level of redefinition of ICT in teaching English, with a low mean score of 1.90 ±1.138.

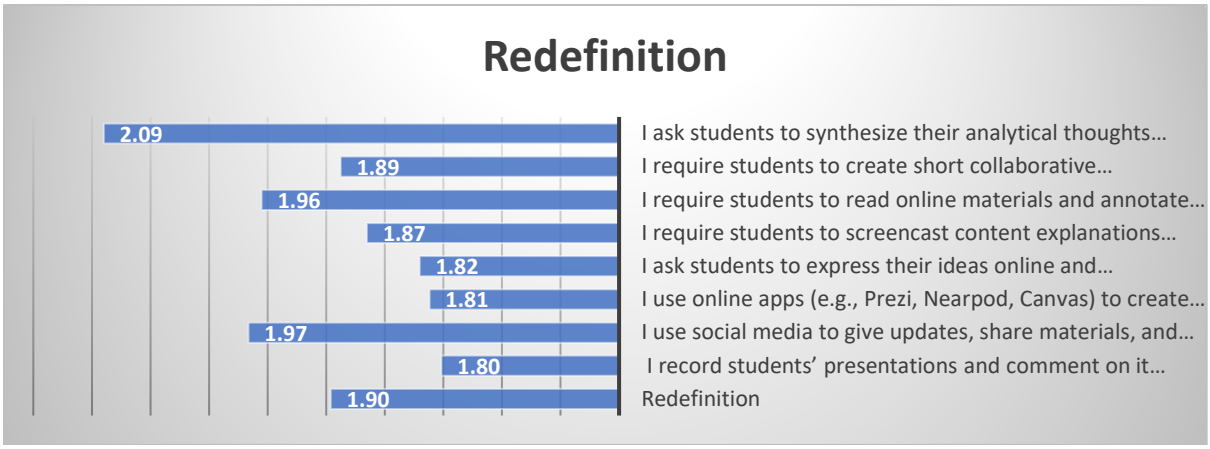


Figure 6. Visual comparison of items across the Redefinition level

Inferential statistics

Normality test result

Normality testing is crucial for several statistical analyses, including the t-test, ANOVA, MANOVA, and regression. Table 2 presents the results of two normality tests: the Kolmogorov-Smirnov and Shapiro-Wilk tests. Both tests show *p*-values greater than 0.05, indicating that the null hypothesis of normality cannot be rejected.

It is essential to note that a sufficiently large sample size can also contribute to normality. The central limit theorem suggests that even if the population data is not normally distributed, the distribution of sample means for larger samples (greater than 40) will tend towards normality (Pallant, 2020). Considering our sample size (89), the central limit theorem further strengthens the assumption of normality.

Based on the results of the normality tests (*p*-values > 0.05) and the relatively large sample size, it is reasonable to assume normality for the variables measuring ICT use in teaching EFL.

Table 2. *Normality test results*

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Substitution	.243	89	.201	.701	89	.200
Augmentation	.115	89	.106	.945	89	.144
Modification	.137	89	.111	.915	89	.125
Redefinition	.216	89	.121	.779	89	.201

Independent Sample T-test

Table 3 presents the results of independent sample t-tests comparing the perceptions of teachers with bachelor's and master's degrees regarding ICT integration in English language teaching. Across all dimensions of ICT integration (substitution, augmentation, modification, redefinition, and overall ICT usage), no statistically significant differences were found between teachers with bachelor's and master's degrees ($p > 0.05$).

Table 3. *Results of the independent sample t-test for differences between teachers' responses towards ICT use in teaching EFL according to their qualification*

	Academic Qualification	N	Mean	Std. Deviation	T	p-value
Substitution	Bachelor	65	4.11	1.295	-0.843	0.402
	Master	24	4.35	.827		
Augmentation	Bachelor	65	3.27	1.205	-0.356	0.723
	Master	24	3.36	.952		
Modification	Bachelor	65	2.31	1.099	-0.742	0.460
	Master	24	2.52	1.309		
Redefinition	Bachelor	65	1.82	1.114	-1.022	0.310
	Master	24	2.10	1.200		

Table 4 presents the results of independent sample t-tests comparing teachers' perceptions regarding ICT integration in English language teaching according to school location. The results show a significant difference in how urban and rural teachers perceive the augmentation of ICT in EFL teaching, favoring urban schools ($p < 0.05$). Otherwise, there are no statistically significant differences between groups in their perceptions regarding substitution, modification, redefinition, and overall ICT usage ($p > 0.05$).

Table 4. *Results of the independent sample t-test for differences between teachers' responses towards ICT use in teaching English according to school location*

	School location	N	Mean	Std. Deviation	T	*p*-value
Substitution	Urban	56	4.32	1.143	1.512	0.134
	Rural	33	3.93	1.237		
Augmentation	Urban	56	3.50	1.119	2.309	0.023*
	Rural	33	2.94	1.095		
Modification	Urban	56	2.46	1.217	0.922	0.359
	Rural	33	2.22	1.045		
Redefinition	Urban	56	1.95	1.205	0.614	0.524
	Rural	33	1.80	1.025		

** Significant at 0.05*

One-Way ANOVA Test

Table 5 shows that there are no statistically significant differences in teachers' perceptions of ICT integration in English language teaching across different experience levels ($P > 0.05$). This finding is based on the similarity of the mean score of the teachers' responses according to their different experiences.

Table 5. *Results of the independent sample t-test for differences between teachers' responses towards ICT use in teaching EFL according to teachers' experience years*

Dimensions	Groups	Mean ± SD	Source	Sum of Squares	df	Mean Square	F	Sig.
Substitution	1-5 years	4.00 ± 1.391	Between Groups	2.811	3	.937	.657	.581
	6-15 years	4.29 ± 0.996	Within Groups	121.240	85	1.426		
	16-25 years	4.38 ± 1.110	Total	124.051	88			
	More than 25 years	4.31 ± 0.953						
Augmentation	1-5 years	3.15 ± 1.216	Between Groups	1.623	3	.541	.410	.747
	6-15 years	3.31 ± 1.044	Within Groups	112.255	85	1.321		
	16-25 years	3.45 ± 1.241	Total	113.878	88			
	More than 25 years	3.50 ± 0.967						
Modification	1-5 years	2.14 ± 1.106	Between Groups	5.046	3	1.682	1.271	.290
	6-15 years	2.34 ± 1.032	Within Groups	112.499	85	1.324		
	16-25 years	2.73 ± 1.400	Total	117.545	88			
	More than 25 years	2.66 ± 1.124						
Redefinition	1-5 years	1.86 ± 1.023	Between Groups	4.395	3	1.465	1.136	.339

	6-15 years	2.03 ± 1.075	Within Groups	109.581	85	1.289		
	16-25 years	2.23 ± 1.495	Total	113.976	88			
	More than 25 years	1.89 ± 0.979						

Qualitative Results

The interviews conducted with teachers provided valuable insights into their perspectives on the use of ICT in EFL classrooms. The data revealed that the teachers' practices predominantly aligned with the *substitution* and *augmentation* levels of the SAMR model. Additionally, the findings highlighted significant barriers that prevented teachers from advancing to the higher levels of *modification* and *redefinition*.

Two major themes emerged from the data: novice users and experienced users. Novice users who are typically less familiar with integrating ICT into their teaching often rely on basic tools and applications that serve as direct substitutes for traditional methods. In contrast, experienced users, who were more adept at incorporating ICT, engaged in practices that went beyond mere substitution, exploring ways to augment their teaching and offer more dynamic learning experiences.

Novice User

At this level, all six teachers mentioned that ICT tools were available in the school; however, these were relatively basic, including the Internet, smartboards, and recording devices for listening skills. Teacher 1 mentioned that she uses YouTube in class to grab the students' attention at the beginning of the lesson and to display instructional videos, such as grammar models, to help them understand the content in a more real-world context. This level of ICT use represents the substitution level. Furthermore, four teachers stated that they were aware of the importance of using ICT in the classroom at higher levels and with a wide range of tools; however, several factors prevented them from doing so. Teacher 6 noted that the school's weak infrastructure was the primary reason she could not use ICT more creatively, especially in urban schools that lack sufficient infrastructure. She stated:

> I have the necessary skills to be creative in teaching English using technological tools that engage students and enhance their understanding of the content. However, I cannot always do that because the school does not have internet access, which sometimes forces me to use my personal phone instead.

Additionally, the lack of equipment and technological tools in some schools contributed to the limited use of ICT at the substitution level. Teacher 4 noted that no personal mobile device was provided for each student, and at the same time, students were not allowed to bring their personal phones to school:

> If I wanted to integrate a program into the classroom, such as educational games or countdown-based technological competitions, they cannot participate individually, which is a significant barrier for them when adequate technological tools are not available to students first and foremost.

Teacher 2 also mentioned:

> On one occasion, I got permission from the school principal to allow students to bring their personal phones for a day to play on the Kahoot app in grammar class. The class was highly

> interactive, and I saw the excitement on my students' faces and their strong engagement, but this is not allowed regularly.

PowerPoint is the primary technological tool relied upon by teachers. Teachers rely on that she consistently uses PowerPoint to teach the four skills of the English language daily. One of the teachers mentioned that her lack of confidence in using ICT was the reason she did not use more tools. The teacher explained that although she uses Google Slides, she is not familiar with many of its features. She uses it only for presentations and does not incorporate animations or embed videos in the slides.

One of the teachers pointed out that the main reason for not expanding the use of ICT was the excessive teaching load. She mentioned that she had 20 teaching hours per week, which left her with no time to prepare effective technological tools, such as images and videos. The teacher teaches high school students and handles daily administrative tasks at the school. She added that if the school reduced her teaching hours, it would create a successful opportunity to think more creatively about using ICT.

Another teacher stated that she was less focused on innovative and technologically advanced approaches to teaching English, as she had to teach courses other than English language, such as science and Arabic for primary school students, due to a shortage of teaching staff. This additional workload limited her ability to fully engage with creative practices or technological integration in her English courses, causing her to prioritize fundamental material in these other fields. As a result, the stress of teaching outside her area of competence and the lack of support limited her ability to experiment with more transformative educational techniques, particularly in the use of ICT.

Experienced User

The teachers in this group use ICT more seamlessly than those in the previous group. They occasionally use Google for content searching and to look up scientific terms. Teacher 3 mentioned, "I sometimes use search engines like Google and Safari to find specific information during lessons, and I search for clarifications of meanings, synonyms, or additional information." Another teacher stated that she uses electronic dictionaries instead of paper dictionaries, which she considers a higher level of substitution. These digital dictionaries offer more detailed explanations to students, including pronunciation and images when applicable. Teacher 2 noted:

> I use electronic dictionaries like Webster, Merriam, and Oxford for the students, and sometimes I ask them to compare these dictionaries for the same meaning. Sometimes, it is a group activity among the students, and other times, I display the results to all the students to initiate a discussion and enrich their understanding.

One teacher explained that she uses Google Translate solely as a tool for helping students look up the meanings of new vocabulary. The use of Google Translate is categorized as augmentation according to Puentedura (2013). She mentioned that this research feature is engaging for students. It provides additional information, such as the option to select different languages for translation, among other features, as students are very excited about this feature.

> In terms of providing educational content to students, Teacher 5 stated:
> I sometimes use free online libraries in my classes and ask students to locate a specific source. They can usually find and access it easily, then share its content with classmates through email or other communication methods, making learning and collaboration more effective.

Two teachers mentioned using Google Docs with their students, encouraging them to create assignments and to share them in groups. This exchange of information via Google Docs represents the augmentation level.

One of the teachers (Teacher 1) explained that she uses bulk messaging with the students via the *Madrasati* platform. She stated:

> I either select all students or send messages to the concerned individuals to send updates or announce any new matters related to the lesson. I select them and send them relevant updates. For example, if there are changes to the schedule or if there are additional explanations they need to know, I always like to make sure everyone has the information they need on time. Also, if there are any new comments or ideas regarding the lesson or any topic we have covered, I try to inform them as soon as possible. Honestly, direct communication individually is sometimes better because it allows for greater clarity, and because each one of them needs special focus or specific information based on their situation in the subject.

The second teacher (Teacher 4) noted that she provides feedback on students' assignments through the *Madrasati* platform. She explained that, through the platform, she sends messages to the students to comment on their work, tasks, and assignments, offering feedback and requesting revisions if necessary, and allowing students to redo and resend their work. Providing students with feedback using ICT is considered a higher level of substitution, as it represents an augmentation of the SAMR model. Teacher 4 also mentioned:

> I use *Madrasati* or Teams when classes are suspended by the school administration. I explain the lesson through technology, provide time for discussion and participation, and divide class into groups for tasks that require group work. They can also share their content, write, and comment during the online lesson.

Another teacher mentioned that she sends the lesson electronically to the students through *Madrasati* before the class time, allowing them to familiarise themselves with the content in advance. She said that this approach has made ICT a significant aid in accelerating understanding, promoting engagement, and capturing attention more effectively. This approach aligns with the flipped classroom model, where students study lessons at home and then practice them in class. However, it represents a lower level of the SAMR model, specifically augmentation, where ICT enhances the effectiveness of learning. However, it does not fundamentally change how learning takes place (Cardullo et al., 2018).

The teachers have used ICT tools extensively; however, their practices represent only the lower levels of the SAMR model. The practices described above are primarily substitution and augmentation, with no mention of using ICT in higher ways that would represent the modification or redefinition levels. Puentedura (2013) clarifies that modification and redefinition of ICT implementation necessitate improved digital awareness and abilities to reach the two levels of ICT transformation. As Mutiary and Lim-Ratnam (2023) noted, providing a stimulating learning environment and continuous training helps teachers better develop their technical practices.

Discussion

The findings indicate that in most cases, ICT is used as an enhancement rather than a transformation. Additionally, the findings demonstrate that teachers do not exceed the level of substitution, as it may be an easier option, or time and effort may play a role in focusing on this level of use (Bicalho et al., 2023). Similarly, Kelsch and Wang (2021) have shown that the use of

ICT in the workplace is often limited to replacing traditional tools with digital ones. This is consistent with our findings, as ICT usage remains at the substitution level in most cases, using PowerPoint and videos as substitutes for the traditional teaching approach. This phenomenon suggests that ICT usage in its initial stages relies heavily on facilitation and effectiveness, without extending to innovation or a radical transformation in instructional practice (Bao et al., 2025).

Most teachers use ICT at a low level, according to the SAMR model, with substitution being the most common and augmentation occurring at a medium level. These are very weak levels, where ICT is used as a substitute for educational content but ultimately achieves the same performance. Research has shown that many teachers are unable to advance to the higher levels of the SAMR model due to several challenges, including inadequate ICT training and resistance to change in the educational environment (Arantes, 2022; Bicalho et al., 2023). In addition, preparedness and understanding of how to use ICT may be reasons, as Levy-Nadav et al. (2026) revealed. Such a limitation may explain why ICT in our study was used only at the substitution and augmentation levels. Marlatt (2018) also showed that using ICT at the substitution and augmentation levels of the SAMR model, rather than focusing on consumption, does not necessarily lead to tangible improvements in student outcomes. Consequently, the use of ICT at these levels remains within the framework of traditional tools, limiting its ability to bring about profound change in teaching methods.

When ICT is used solely at the substitution level, it is primarily used as a replacement rather than an enhancement, which can lead to students feeling disengaged or unmotivated. If ICT is used to replace textbooks and educational tasks without introducing new dimensions or more creative ways to interact with the teacher, its impact on engagement will be minimal or almost non-existent. This finding is consistent with those of Bicalho et al. (2023), and Alfiana et al. (2022), who showed that using ICT solely to deliver traditional content reduces student engagement, leading to a poor learning experience. Although ICT provides an effective means of delivering content, Mutiary and Lim-Ratnam (2023) emphasised that using it as a replacement tool alone, such as replacing a textbook with an electronic programme, does not contribute to enhance student motivation or effective engagement. The results of our study also show that teachers use ICT without adding new dimensions or innovative opportunities for interaction between students and teachers, and its impact on student motivation is minimal.

Urban teachers use ICT at a higher level, *augmentation*, which may reflect the better infrastructure available in cities rather than rural areas. School infrastructure is one of the most significant barriers to the effective use of ICT. Although teachers demonstrated a willingness to use ICT effectively, access to the Internet and easy connectivity were major obstacles. These barriers are consistent with those reported by Bicalho et al. (2023). Therefore, it is necessary to invest more resources in improving infrastructure. Schools must provide high-speed Internet and appropriate devices for each student, which may contribute to an integrated learning environment that supports the effective use of ICT.

Furthermore, excessive teaching loads and the assignment of administrative tasks limit teachers' ability to use ICT more innovatively. This can be addressed by reducing weekly teaching hours or allocating time for preparation and the use of technological tools. Time constraints and increased workload are among the most significant barriers to the effective integration of ICT, as noted in previous studies (Mishra & Kohler, 2006; Schmidt, 2009). This can contribute to enable teachers to fully utilize ICT in developing lessons and delivering distinctive educational content. Despite these limitations, the results showed that some teachers, especially experienced ones,

demonstrated their ability to explore and utilize multiple technologies, such as electronic dictionaries and translation applications, to support student learning. However, these practices remain at the substitution and augmentation levels. The findings align with the SAMR model developed by Puentedura (2006), which categorises ICT integration into four levels: substitution, augmentation, modification, and redefinition. The observed results did not demonstrate any practices that clearly and radically fall within the levels of modification and redefinition.

Collaboration among teachers can be enhanced by encouraging them to share experiences, work together, and utilize technological tools. According to Kalonde (2024), an innovative learning environment can be created by creating educational platforms to share educational resources or organizing joint workshops where teachers from all disciplines can learn how to integrate ICT into teaching more effectively and creatively.

Similarly, Kopcha et al. (2023) emphasized that training opportunities must also be provided, as some teachers lack confidence and feel unfamiliar with specific powerful ICT tools, despite having basic skills. Puentedura (2013) recommended that it is essential to provide effective professional development for teachers to use ICT more creatively, including integrating ICT into teaching to promote movement towards the modification and redefinition levels of the SAMR model.

Conclusion

The findings revealed that EFL teachers primarily used ICT at the substitute level of the SAMR model, with minimal application for augmentation and the other two higher levels. ICT integration focused on replacing teaching practices rather than transforming learning experiences.

The implications of this study suggest the need to improve the technological infrastructure, provide ongoing teacher training, reduce teaching workload, and promote collaboration among teachers, thereby enabling significant progress in integrating ICT into education. These steps will motivate teachers to use ICT innovatively, thereby enhancing the quality and effectiveness of education and providing students with a comprehensive and diverse educational experience. The report also urges educational officials to provide schools with more targeted guidance and resources to ensure that ICT integration is implemented successfully and sustainably. Finally, future research could investigate the long-term effects of ICT integration, particularly in diverse cultural and educational contexts, to better comprehend the SAMR model's global relevance in EFL instruction.

This study faces several limitations that should be considered when interpreting the results. First, the sample size is relatively limited (89 female teachers), which may affect the generalisability of the findings to a broader population. Second, the study was conducted in only one geographical region (Hail City), which may limit the applicability of the results to other regions with different characteristics. Third, the study was restricted to female teachers due to the gender-segregated nature of the educational system in Saudi Arabia, which made it difficult for the female researcher to access male schools under prevailing cultural and social constraints. Therefore, future research should include larger and more diverse samples from multiple regions and both genders to enhance the generalisability and accuracy of the findings.

Funding: This research is not funded
Acknowledgments: The authors would like to express sincere appreciation to the English teachers at the participating secondary schools for their valuable cooperation in facilitating data collection.

Conflicts of Interest: There is no conflict of interest
Authenticity: This manuscript is an original work
Artificial Intelligence Statement: AI tool/s (ChatGPT) was used only for language improvement and proofreading. The author reviewed and revised all content and take full responsibility for the manuscript.

About the Author:
Dr. Jawza Alshammari is an assistant professor in the English Language Department at University of Hail, Saudi Arabia. Her research interests include teaching and learning EFL and ESL, digital technology in EFL education, second language acquisition, learning theories and qualitative research. ORCiD ID: http://orcid.org/0009-0001-9322-8375

References
Abdelhalim, S. M. (2025). From traditional writing to digital multimodal composing: promoting high school EFL students' writing self-regulation and self-efficacy. *Computer Assisted Language Learning*, *38*(8), 1795–1824. https://doi.org/10.1080/09588221.2024.2322148

Abraham, D. M., & Padmakumari, P. (2026). Developing qualitative interview guides: A methodological framework for novice researchers. *Nurse Education Today*, *163*, 107116. https://doi.org/https://doi.org/10.1016/j.nedt.2026.107116

Al Hajri, M., Bani Orabah, S., Domalaon, D., & Bijani, H. (2025). Evaluating the Quality of Blended Learning in Higher Education: Teachers' and Students' Perceptions in an Omani EFL Context *Arab World English Journal (AWEJ) Special Issue on CALL (11)*:20- 42. doi: https://dx.doi.org/10.24093/awej/call11.2

Ali, A. (2024). Locating the Intersection of Generative Artificial Intelligence and Human English Writing Skills: A Comparative Study. *Arab World English Journal (AWEJ)* Special Issue on ChatGPT, April 2024: 112-123. doi: https://dx.doi.org/10.24093/awej/ChatGPT.7

Alshammari, J. (2024). Revolutionizing EFL learning through ChatGPT: A qualitative study. *Revista Amazonia Investiga*, *13*(82), 208–221. https://doi.org/10.34069/AI/2024.82.10.17

Arantes, J. (2022). The SAMR model as a framework for scaffolding online chat: A theoretical discussion of the SAMR model as a research method during these "interesting" times. *Qualitative Research Journal*, *22*(3), 294–306. https://doi.org/10.1108/qrj-08-2021-0088

Alfiana, H., Karyono, H., & Gunawan, W. (2022). The application of SAMR model and self-efficacy on critical thinking and procedural knowledge. *LLT Journal: A Journal on Language and Language Teaching*, *25*(1), 200–217. https://doi.org/10.24071/llt.v25i1.3893

Bao, W., Wang, T., Zhang, L., Yusop, F. D., & Ruan, X. (2025). A systematic review of AI in second language acquisition using the expanded SAMR model (2015–2024). *Discover Computing*, *28*, 292. https://doi.org/10.1007/s10791-025-09833-6

Bicalho, R. N. D. M., Coll, C., Engel, A., & Lopes de Oliveira, M. C. S. (2023). Integration of ICTs in teaching practices: Propositions to the SAMR model. Educational Technology Research and Development, 71(2), 563–578. https://doi.org/10.1007/s11423-022-10169-x

Bui, T. H. (2022). English teachers' integration of digital technologies in the classroom. *International Journal of Educational Research Open*, *3*, 100204. https://doi.org/https://doi.org/10.1016/j.ijedro.2022.100204

Buledi, M., & Badariah, T. (2024). Exploring digital technology usage among English language instructors at a Saudi higher education institution and validating a hierarchical structure of usage based on the SAMR model. *IIUM Journal of Educational Studies*, *12*(1), 90–111. https://doi.org/10.31436/ijes.v12i1.446

Calamlam, J. (2020). The development of 21st-century e-learning module assessment tool. *Journal of Educational Technology Systems*, *49*(3), 289–309. https://doi.org/10.1177/0047239520953792

Cardullo, V. M., Wilson, N. S., & Zygouris-Coe, V. I. (2018). Enhanced student engagement through active learning and emerging technologies. In *Information and technology literacy: Concepts, methodologies, tools, and applications* (pp. 1112–1130). IGI Global. https://doi.org/10.4018/978-1-5225-3417-4.ch058

Creswell, J. W., & Clark, V. L. P. (2017). *Designing and conducting mixed methods research*. Sage Publications.

Creswell, J. (2024). My 35 years in mixed methods research. *Journal of mixed methods research*, *18*(3), 203–215. https://doi.org/10.1177/15586898241253892

Cui, T., & Coleman, A. (2021). Investigating students' attitudes, motives, participation and performance regarding out-of-class communication (OCC) in a flipped classroom. *The Electronic Journal of E-Learning*, *18*(6), 550–561. https://doi.org/10.34190/jel.18.6.007

Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods*, *5*(1), 80–92. https://doi.org/10.1177/160940690600500107

Golonka, E. M., Bowles, A. R., Frank, V. M., Richardson, D. L., & Freynik, S. (2014). Technologies for foreign language learning: A review of technology types and their effectiveness. *Computer Assisted Language Learning*, *27*(1), 70–105. https://doi.org/10.1080/09588221.2012.700315

Hamilton, E. R., Rosenberg, J. M., & Akcaoğlu, M. (2016). The substitution augmentation modification redefinition (SAMR) model: A critical review and suggestions for its use. *TechTrends*, *60*(5), 433–441. https://doi.org/10.1007/s11528-016-0091-y

Hashim, N., Matraf, M., & Hussain, A. (2021). Identifying the requirements of visually impaired users for accessible mobile e-book applications. *JOIV International Journal on Informatics Visualization*, *5*(2), 99–104. https://doi.org/10.30630/joiv.5.2.398

Hembrough, T., & Jordan, J. (2020). Creating a digital writing classroom: A mixed methods study about a first-year composition tablet initiative. *International Journal of Instruction*, *13*(2), 567–586. https://doi.org/10.29333/iji.2020.13239a

Huang, Y., Pan, L., Wang, Y., Yan, Z., Chen, Y., Hao, X., & Xia, T. (2023). Exploring the user acceptance of online interactive mechanisms for live-streamed teaching in higher education institutions. *Sustainability*, *15*(18), 13529. https://doi.org/10.3390/su151813529

Kelsch, J., & Wang, T. (2021). An action research of using SAMR to guide blended learning adoption during COVID-19. In W. Jia, et al. (Eds.), Emerging technologies for

Education. SETE 2021 (Vol. 13089). Springer. Lecture Notes in Computer Science. https://doi.org/10.1007/978-3-030-92836-0_18

Kopcha, T., Neumann, K., Ottenbreit-Leftwich, A., & Liao, Y. C. J. (2023). What works in technology integration professional development? A synthesis of US studies from 2008–2019. *Journal of Technology and Teacher Education*, *31*(4), 401–457.

Kumi-Yeboah, A., Sallar, A.W., Kiramba, L.K., & Kim, Y. (2020). Exploring the use of digital technologies from the perspective of diverse learners in online learning environments. *Online Learning*, *24*(4), 42–63. https://doi.org/10.24059/olj.v24i4.2323

Leary, H., Lee, V., & Recker, M. (2021). It's more than just technology adoption: Understanding variations in teachers' use of an online planning tool. *Techtrends*, *65*(3), 269–277. https://doi.org/10.1007/s11528-020-00576-3

Levy-Nadav, L., Shamir-Inbal, T., & Blau, I. (2026). What are teachers' perspectives and practices regarding the integration of GenAI tools in pedagogical design and classroom instruction? *Education and Information Technologies*, *31*(10), 3511-3536. https://doi.org/10.1007/s10639-026-13925-1

Marlatt, R. (2018). "I didn't say, 'Macbeth,' it was my Google Doc!": A secondary English case study of redefining learning in the 21st century. *E-Learning and Digital Media*, *16*(1), 46–62. https://doi.org/10.1177/2042753018817544

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, *108*(6), 1017–1054. https://doi.org/10.1177/016146810610800610

Morgan, D. L. (2007). Paradigms post and pragmatism regained: Methodological implications of combining qualitative and quantitative methods. *Journal of Mixed Methods Research*, *1*(1), 48–76. https://doi.org/10.1177/2345678906292462

Mutiary, L., & Lim-Ratnam, C. (2023). Choosing relevant internet-assisted approaches for professional development courses. *International Journal of Information and Education Technology*, *13*(11), 1672–1680. https://doi.org/10.18178/ijiet.2023.13.11.1976

Nazim, M. (2024). Exploring EFL teachers' insights regarding artificial intelligence driven tools in student-centered writing instructions. *International Journal of English Linguistics*, *14*(3), 93–107 https://doi.org/10.5539/ijel.v14n3p93

Pallant, J. (2020). *SPSS survival manual: A step-by-step guide to data analysis using IBM SPSS*. Routledge. https://doi.org/10.4324/9781003117452

Puentedura, R. R. (2006, November 28). Transformation, technology, and education in the state of Maine [Web log post]. Hippasus. http://www.hippasus.com/rrpweblog/archives/2006_11.html

Puentedura, R. R. (2013, May 29). SAMR: Moving from enhancement to transformation [Web log post]. Hippasus. http://www.hippasus.com/rrpweblog/archives/000095.html

Schmidt, D. A., Baran, E., Thompson, A. D., Mishra, P., Koehler, M. J., & Shin, T. S. (2009). Technological pedagogical content knowledge (TPACK) the development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education*, *42*(2), 123–149. https://doi.org/10.1080/15391523.2009.10782544

Shadiev, R., & Yang, M. (2020). Review of studies on technology-enhanced language learning and teaching. *Sustainability*, *12*(2), 1–22. https://doi.org/10.3390/su12020524

Shannon-Baker, P. (2016). Making Paradigms Meaningful in Mixed Methods Research.

Journal of Mixed Methods Research, *10*(4), 319–334. https://doi.org/10.1177/1558689815575861

Son, T. (2024). Intelligent tutoring systems in mathematics education: A systematic literature review using the substitution, augmentation, modification, redefinition model. *Computers*, *13*(10), 1–24. https://doi.org/10.3390/computers13100270

Wang, H. (2021). Design and implementation of English learning platform for college school students based on virtual community and image processing technology. *International Journal of Electrical Engineering Education*, *60*(2_suppl), 362–376. https://doi.org/10.1177/0020720920986072

Xodabande, I. (2018). Iranian EFL learners' preferences of different digital technologies for language learning beyond the classroom. *International Journal of Education and Literacy Studies*, *6*(3), 20–31. https://doi.org/10.7575/aiac.ijels.v.6n.3p.20

Zakaria, N.Y.K., Hashim, H., & Jamaludin, K. A. (2025).Mobile Technology for Enhanced ESL Writing Education: A Systematic Review of Benefits and Pedagogical Innovations. *Arab World English Journal (AWEJ) Special Issue on CALL (11).* :210-222. https://dx.doi.org/10.24093/awej/call11.1

Zarraonandía, T., Díaz, P., Montero, Á., Aedo, I., & Onorati, T. (2019). Using a Google Glass-based classroom feedback system to improve students to teacher communication. *IEEE Access*, *7*, 16837–16846. https://doi.org/10.1109/access.2019.2893971

Zhaı, X., Zhang, M., Li, M., & Zhang, X. (2018). Understanding the relationship between levels of mobile technology use in high school physics classrooms and the learning outcome. *British Journal of Educational Technology*, *50*(2), 750–766. https://doi.org/10.1111/bjet.12700