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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

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Abstract

This study examined the usage of digital technology among English language instructors at a public university in Saudi Arabia as perceived by their students and tested the notion that such usage could be ranked in hierarchical levels. The SAMR model, developed by Puentedura (2014), was employed to categorise and rank technology usage into four incremental levels, i.e., Substitution, Augmentation, Modification and Redefinition, with Substitution being the most rudimentary level and Redefinition being the highest and most sophisticated usage. A 32-item questionnaire rated on a 5-point Likert scale measuring how frequently English language instructors used technology at the four SAMR levels was developed by the authors, content-validated by six instructional technology experts and pilot-tested with 63 students prior to its use in the actual survey. Data were gathered from a survey sample of 535 Saudi learners studying English in their foundation year programme and analysed using three statistical procedures, i.e., descriptive statistics, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The descriptive results pointed to instructors' technology usage revolving around the Substitution level of the SAMR model, indicating a predominant tendency among instructors to merely replace traditional teaching tools with digital alternatives. The EFA procedure (via Principal Axis Factoring with Promax rotation) produced conflicting results. While the extracted factor structure supported only two levels of usage, the scree plot suggested the existence of four usage levels consistent with the SAMR model. This was addressed by the subsequent CFA procedure performed on the data that confirmed the four SAMR levels, with the fit statistics indicating a good-fitting technology usage model; $\chi2(98) = 268.73$; $\chi2/df = 2.74$; CFI = .94; RMSEA = .078, CI: .067, .090. Sixteen out of the 32 technology usage items were successfully extracted and confirmed as the indicators SAMR's four levels. The results corroborated previous findings that technology utilisation among English instructors is pervasive but rudimentary. They also supported the theoretical notion that technology usage can be categorised, ranked, and understood in hierarchical levels as purported by the SAMR model.

Keywords: *SAMR model, technology integration, pedagogical levels of technology usage, English language teaching, construct validation via CFA*

INTRODUCTION

In Saudi Arabia, technology usage in English language teaching started in the 2000s when computers became affordable to the public (Aljohani, 2016; Mahboob & Elyas, 2014; Abouelnaga et al., 2019)—although technology in a far broader sense has been used by Saudi teachers since as far back as the 1960s (Hammond & Gamlo, 2015). To enhance Saudi students' learning of English, language teachers and instructors working at the various English language institutes across Saudi Arabia are given round-the-clock access to a wide range of computer devices, mobile applications, and learning management systems. They also have the benefit of constant technology updates, new technology tools and recent software versions, all of which appear to be crucially important in Saudi education today (Al-Amri & Almaiah, 2020). In particular, the widespread use of smartphones (Ullah & Anwar, 2020), laptops, social media (Allam & Elyas, 2016; Alghamdi, 2018) and interactive whiteboards (Alghamdi & Higgins, 2018) is immensely impacting Saudi higher education. Wireless Access Points (WAPs) are ubiquitous in Saudi's educational infrastructure. This is well-documented in myriad studies on technology integration into English language teaching in various classroom settings across the nation, especially in higher education (Allison, 2022; Alqarni, 2015, 2017; Al-Shehri, 2020; Keengwe, 2020). Hence, the issues of access and equipment readiness (Chapnick, 2000) are not the points of contention in discussing Saudi educators' technology usage. A more relevant question to ask, at this juncture, is *how* technology is being used by Saudi teachers to teach important skills and subject matter knowledge, such as mastery of the English language, which is critical to Saudi students' access to a worldwide repertoire of information.

Current empirical literature informs us that technology is considerably integrated into Saudi students' learning of English. Two significant moves by the Saudi government have propelled English teachers and instructors greater toward adopting digital technology. First, the Ten Year (2004-2014) Educational Plan or the "Tatweer" project, launched by the Saudi Ministry of Education in 2005, began a significant reform in Saudi education. It included increasing Saudi schools and universities' equipment readiness by providing them with digital devices like projectors, laptops, and smartboards, and training Saudi teachers to use them appropriately. Some 400,000 educators were trained toward this end (Al-Harbi & Alshumaimeri, 2016; Alshumaimeri, 2008). English language instruction was a major focus of the "Tatweer" project (Wedell & Alshumaimeri, 2014) and had its own name, i.e., the English language development project (ELDP), where international experts were hired to produce customised learning materials to fit the Saudi learning context. Apart from textbooks, teachers' reference guides and student workbooks, the experts also developed visual and audio resources, e-learning materials in CD-ROMs, web portals and e-books specifically for the teaching and learning of English for Saudi students (Alshumaimeri, 2019). Scores of studies have demonstrated the effectiveness and benefits of technology usage for Saudi learners through mobile apps and gamification tools (e.g., Alzahrani et al., 2018; Dellos, 2015; Smith & Brauer, 2018). Second, with the introduction of Saudi's Vision 2030 in 2016 that placed technology and innovation as one of the core components of national development, English language teachers and instructors are expected to further increase their technology adoption to improve Saudi learners' experience in the English classroom (Allmnakrah & Evers, 2020).

Al-Shehri (2020) argues that teachers and university instructors' use of technology matters in the Saudi effort to transform its English language teaching. He writes, "the introduction of technology into English instruction [is] meant to improve pedagogical practices in general because most students are still

teacher-dependent and lack appropriate self-learning skills" (p. 110). This being the aim, it is thus critical that teachers and instructors use technology appropriately at appropriate pedagogical levels to empower students with the targeted autonomy and self-learning skills. But according to Hammond and Gamlo (2015), "for the most part, [teachers'] use of ICT in the classroom was limited… [T]he use of data projection was widespread, with both male and female teachers often projecting materials from the textbook CD, using PowerPoint or other presentation software in their lessons… A further use of projection involved the display of students' writing, shown with errors corrected interactively using a colour-coded system" (p. 5). Mostly, teachers' use of technology is limited to PowerPoint presentations to teach grammar and vocabulary and to topic revisions. Other uses include "searching for advice on teaching, accessing resources for direct use in teaching and providing links for students…searching YouTube specifically for video clips and online material relating to TESL and ESL, or [going] directly to resources offered by English Club, BBC and the British Council" (p. 6). The authors report that "most [technology] use was restricted and… ICT was [only] routinely used for... projecting slides, [and] completing online portfolios" (p. 6). Although technology can help students to become more independent, an important aim of Saudi education, teachers' use of it is unfortunately very restricted. "Extended users of ICT were a minority…[who] pushed the use of ICT, for example, a few created blogs to support learning outside the classroom...to provide opportunities for collaboration amongst students and to archive discussions and resources" (Hammond & Gamlo, 2015, p. 6). This minority group experimented with online collaborative learning and allowed handphones to be used for lesson recording.

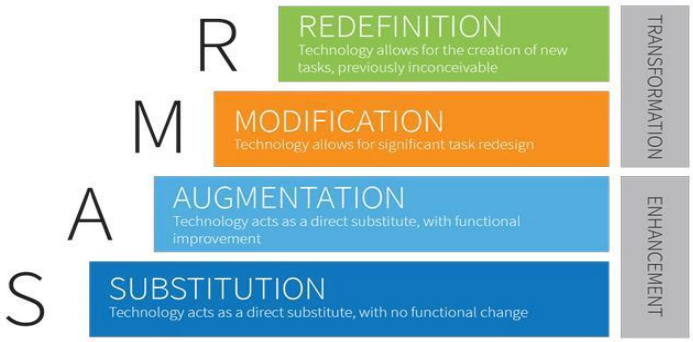
Alshammari et al. (2022) believe that Saudi teachers lack the technological ability to use ICT meaningfully, but it may well be that they also fall short of the pedagogical knowledge to use technology in disruptive ways beyond their normal routines of projecting slides and sharing YouTube videos. To date, there is a scant amount of recent research that describes whether Saudi English teachers or instructors are using technology in pedagogically disruptive ways to empower student autonomy and independent learning (Alqurashi et al., 2017), hence the present study.

THEORETICAL FRAMEWORK: THE SAMR MODEL

The SAMR model (Puentedura, 2014) suggests that technology usage can be categorised and ranked into four hierarchal levels, i.e., *Substitution, Augmentation, Modification* and *Redefinition*. Each level reflects a different type of pedagogy and progresses in complexity as it goes up the hierarchy. The levels are shown in Figure 1.

Figure 1

The SAMR Model (Puentedura, 2014)



In the first level, *Substitution,* instructors use technology simply as a substitute for the traditional way of implementing a learning activity. There is no functional change in this level of technology usage. In other words, the learning task or activity could be accomplished without the use of the technology, and the technology simply replaces the traditional tool without qualitatively altering students' learning experience. For example, having students write their essays in MS Word instead of in their writing books. The task (i.e., writing an essay) remains the same although in the former example, the activity involves some technology use.

The second level, *Augmentation,* is qualitatively one rung higher than substitution. At this level, the technology used provides some functional improvement to the task and enhances the student's learning experience, but there is still no significant change in the task itself. Technology adds value or efficiency to the task, making it easier to complete it but in essence, the task can still be accomplished without the use of technology. For example, getting students to use a grammar checker, spell-checker, or formatting tools in MS Word to enhance the writing of their essay. Students can still write their essays without using these features in Word.

The third level, *Modification,* involves a significant task redesign where the use of technology results in a substantial change to the task or activity, leading to new possibilities that were not previously achievable without technology. For example, having students from different places or different parts of the world collaborate in real time to write an essay using Google Docs. Prior to the invention of the sharing capability, real time collaborative writing involving students in different locations was not possible. Another example is having students create a video response to a given topic on Padlet or Flipgrid instead of writing an essay on the topic. The response can later be sent to teachers and parents for feedback, thereby galvanising parental participation in students' learning. Hence, modification is hailed as the first step over the line between enhancing traditional learning tasks in the classroom and transforming the classroom through technology tools.

The fourth and last level, *Redefinition,* is the highest form of technology usage. It allows creating new tasks that were previously inconceivable. For instance, before the advent of virtual reality, it was impossible to "transport" students to another place from an ancient era. But today, through virtual trips, students can "visit" the palace of Cleopatra or the Prophet's (PBUH) house in Mecca or Madinah or go inside the skeleton of a whale to examine its structure. Another example of technology usage at the *Redefinition* level is employing digital simulations to bolster students' understanding of plate tectonics and earthquakes, phenomena that cannot be authentically understood by merely watching a video, examining photographs, or listening to a static lecture. At this level, technology usage is disruptive and goes beyond the rudimentary routines of displaying lecture notes on projector screens and entering assessment marks into a digital database.

To summarise, the SAMR model encourages educators to move beyond the ordinary—beyond simply using technology to substitute traditional tools. It guides educators in creating disruptive, transformative uses of technology that redefine how learning occurs (Arantes, 2022). The model also helps educators to think more critically about the impact of their technology usage on student learning

and to aim for deeper, more meaningful technology-enhanced lessons that truly call for student engagement with content and tasks.

RESEARCH OBJECTIVES

This research has a threefold objective, the first of which is to describe the usage of digital technology among English language instructors at a Saudi public university and to place instructors' utilisation on the SAMR continuum. Second, through the application of EFA, it seeks to determine if the underlying factor structure of instructors' technology usage complies with the SAMR model (i.e., the four usage levels). Third, it aims to validate a four-factor structure of technology usage based on the four levels of SAMR.

METHODOLOGY

Research Design

To achieve the stated objectives, the study employed a combination of descriptive, exploratory and confirmatory research approaches using cross-sectional survey data. The research followed the positivist paradigm and was *ex-post facto* in nature as it involved no intervention or experimental manipulation of the constructs by the researchers. Kerlinger (1964) defines *ex post facto* research as a type of research where the variables to be measured have already occurred in their natural setting and in which the researcher starts with an observation of the variables. All constructs in this study were measured using a self-developed SAMR questionnaire validated by experts in the field of instructional technology.

Population and Sample

The population was all foundation year Arab students studying English at the language institute of the selected university in Saudi Arabia. The sample comprised 535 students of this population pool. They were 19-year-old native Arabic speakers taking English courses from various instructors (mostly ex-patriates) who were using technology at varying levels and degrees; hence the students were in the correct position to rate the instructors' usage of technology. The sample was randomly split into two halves for the purpose of running EFA (n1 = 250) and CFA (n2 = 285), while a descriptive analysis of instructors' technology usage levels was performed on all 535 cases. Table 1 summarises the characteristics of the two subsamples.

Table 1

Respondents' Characteristics by Subsample (N = 535)

Characteristic	Level	n1 (250)		n2 (285)	
		n1	%	n2	%
Gender	Male	236	94.4	274	96.1
	Female	14	5.6	11	3.9
Ethnicity	Arab	208	84.6	261	93.2
	Asian	38	15.4	19	6.8
Mode of Study	Fulltime	150	61.2	175	63.2
	Parttime	95	38.8	102	36.8
Level of English	101	73	29.9	42	14.8
	102	54	22.1	119	41.9
	103	98	40.2	116	40.8
	104	19	7.8	7	2.5
Age	Mean	19.84		19.43	
	SD	5.07		3.72	

Survey Instrument

The study developed a 32-item questionnaire (shown in full in Table 3 appearing later in the report) based on SAMR to measure English instructors' usage of technology as perceived by their students. The operational definitions of *Substitution, Augmentation, Modification* and *Redefinition* were first clarified, followed by item creation and mapping of the items into the four levels. A five-point response scale, ranging from *Always (5)* to *Never (1)*, was adopted to capture the frequency of technology usage among instructors. Six (6) instructional technology experts familiar with the SAMR model were employed to validate the items, after which the questionnaire was pilot-tested on a predominantly male sample of 63 Saudi students from the same population pool. Based on the pilot data, the reliabilities of the construct measurements were then estimated (Table 2), producing the following indexes which proved to be acceptable:

Table 2

Reliability Estimates of the Construct Measurements (n_p = 63)

Construct	No of Items	Cronbach's Alpha
Substitution	8	.87
Augmentation	8	.91
Modification	8	.93
Redefinition	8	.94

DATA COLLECTION AND ANALYSIS

The survey was administered via a Google Form and placed online for three months to gather the required number of responses. The survey data was collated into an Excel sheet. It was then imported into SPSS (version 23) and subjected to three types of statistical analysis, i.e., descriptive statistics (by means of percentages, means and standard deviations), EFA (by means of Principal Axis Factoring and Promax rotation), and CFA (by means of a maximum-likelihood estimation). In the descriptive analysis, instructors' technology usage was represented by the percentages of students rating the items as *"Always"* and *"Frequently".* These two responses were collapsed into just one category to represent instructors' usage of technology by SAMR level. A visual inspection of item means was conducted to identify and place instructors' technology utilisation across the SAMR continuum.

For the PAF analysis, the study relied on the scree plot and factor interpretability to ascertain the underlying factor structure of the data on English instructors' technology usage, after considering the data's correlation matrix, sampling adequacy, communalities, eigenvalues, proportion of variance explained, and factor loadings. PAF revisions were made based on these two main components of analysis. For the CFA procedure, the analysis employed the maximum-likelihood (ML) estimation method and estimated the goodness of fit (GOF) of the proposed model of English instructors' technology usage using three GOF criteria, namely absolute fit, incremental fit, and parsimonious fit.

RESULTS

Digital Technology Usage among English Language Instructors: Descriptive Results

Table 3 tabulates English instructors' usage of digital technology in teaching the language as reported by their foundation year students. The percentages shown in the table indicate how frequently digital technology was used by instructors to teach the relevant language components and skills.

Table 3

English Instructors' Usage of Digital Technology by SAMR Level (N = 535)

Code	Technology Usage	%	M	SD
S1	Using the Smartboard instead of the traditional whiteboard	61.9	3.74	1.44
S2	Using the textbook in softcopy rather than hardcopy	52.8	3.65	1.34
S3	Using the projector to display information or notes	72.9	4.14	1.28
S4	Conducting listening activities on students' smartphones	51.3	3.44	1.51
S5	Using the LMS to assign homework	70.4	4.05	1.26
S6	Using WhatsApp/Telegram groups for course updates	67.7	3.92	1.42
S7	Using Blackboard instead of workbooks for review exercises	60.2	3.76	1.33
S8	Using PowerPoint for whole class instruction	53.8	3.51	1.48

Table 3

(continued)

Code	Technology Usage	%	M	SD
A1	Giving class feedback via the LMS	54.8	3.57	1.40
A2	Creating video lessons and sharing them on class WhatsApp	42.1	2.95	1.62
A3	Using MS Word features like track changes to highlight writing errors	48.6	3.35	1.49
A4	Adding hyperlinks to homework assignments for more information	47.2	3.31	1.47
A5	Employing gamification apps (e.g., Kahoot & Quizizz) for language practice and assessment	56.2	3.50	1.54
A6	Using translation apps (e.g., Google Translate) to help students understand words and phrases	36.6	2.85	1.58
A7	Using Web 2.0 tools (e.g., Quizlet, Word Hippo) to teach vocabulary	41.9	3.03	1.61
A8	Recording feedback on students' work and sharing it online	47.8	3.28	1.53
M1	Hyperlinking resources as feedback to students to encourage further learning	51.0	3.38	1.49
M2	Having students create video snippets and share them online	31.7	2.65	1.57
M3	Having students use videos and images to enhance their written tasks	37.3	2.92	1.55
M4	Having students write and share various pieces (e.g., an opinion or a poem) online	34.3	2.82	1.56
M5	Using interactive navigation apps (e.g., Google Earth or Waze) to practise language items	38.5	2.96	1.55
M6	Having students write and comment on poems and stories online (e.g., using Storybird)	33.8	2.71	1.57
M7	Using digital platforms on students' smartphones to teach language skills	52.2	3.43	1.51
M8	Using cloud tools (e.g., Google Docs, Padlet or Pinterest) to conduct collaborative learning activities	43.0	3.13	3.22
R1	Having students synthesise their analytical thoughts using multimedia tools	43.3	1.53	1.46
R2	Requiring students to create short collaborative documentaries using multimedia tools	30.0	2.55	1.58
R3	Requiring students to read online materials and annotate difficult words	41.4	3.06	1.54
R4	Requiring students to screencast content explanation and share it for collaborative feedback	37.5	2.94	1.57
R5	Having students express ideas online and collaborate with other classmates for feedback	38.8	2.93	1.57
R6	Using online apps (e.g., Prezi, Nearpod, Canva) to create and share hyperlinked presentations	42.7	3.10	1.56
R7	Using social media to give updates, share materials and provide feedback	51.2	3.42	1.53
R8	Recording students' presentations and commenting on them online as feedback	44.0	3.19	1.55

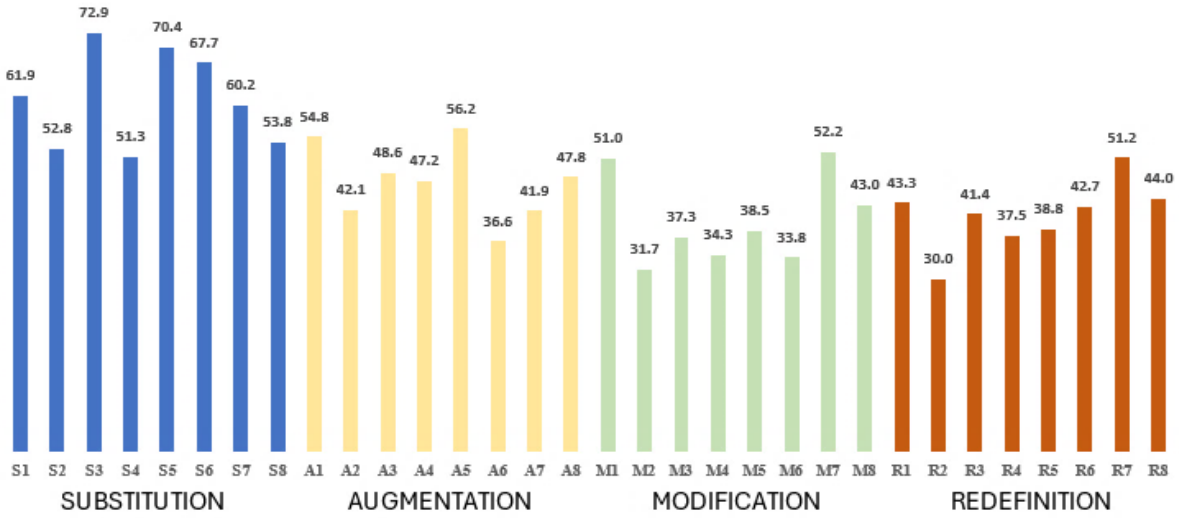
Several noteworthy observations can be made based on the descriptive data. First, the most frequent technology usage by English instructors revolved around using the following tools and purposes: *"the projector to display information and notes"* (72.9%), *"the LMS to assign homework to students"* (70.4%), *"WhatsApp/Telegram groups for course updates"* (67.7%), *"the smartboard instead of the traditional whiteboard"* (61.9%), *"Blackboard instead of workbooks for review exercises"* (60.2%), and *"PowerPoint for whole-class instruction"* (53.8%). In SAMR, these uses represent the *Substitution* level— that is, the lowest or the most basic level or category of technology utilisation in regard to pedagogy. These five items were rated "4" or close to "4" on the average, suggesting their frequent uses among English instructors.

Second, technology was least used for synthesising and promoting analytical thought, a pedagogically challenging activity to do even with the help of technology. This item had the lowest mean (M = 1.53, SD = 1.46) with 43.3% reported usage among instructors. Third, most items hovered between 41 and 56% reported usage, indicating that the uses of the stated activities (e.g., *using cloud and web-based tools* and *creating video lessons*) occurred only sometimes in Saudi students' English language learning experiences. Fourth, rated least on the frequency scale by the student respondents were activities involving *multimedia use, video creation and screencasting, collaborative learning, writing literary works online,* and *using navigation and translation apps for learning English.*

The analysis proceeded to convert Table 3 data into a visual form (Figure 2) to give a clearer picture of English instructors' technology utilisation as reported by their students.

Figure 2

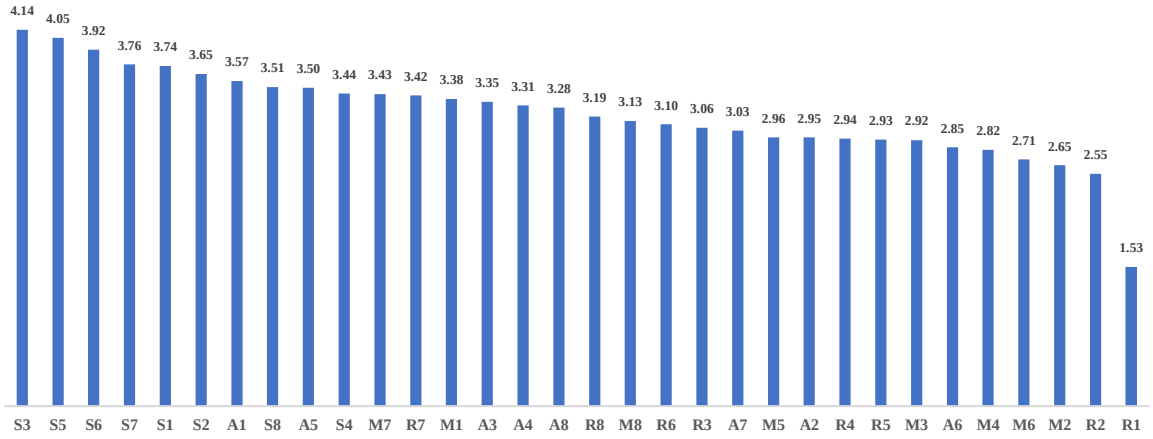
Distribution of English Instructors' Technology Usage Across SAMR Levels



As clearly seen in Figure 2, usage was generally higher in the *Substitution* dimension, while the patterns of utilisation in the other three dimensions did not demonstrate very distinct differences. The patterns of technology usage among English instructors appear similar across the *Augmentation*, *Modification* and *Redefinitio*n levels although the reports for *Augmentation* were slightly higher than those for the upper two levels. A further visual inspection of the item means (Figure 3) indicates that technology usage in English language teaching occurred mostly at the basic levels (i.e., *Substitution* and *Augmentation*).

Figure 3

Visual Comparison of SAMR Item Means (N = 535)



High-level usage (i.e., *Modification* and *Redefinition*) was sporadic, happening only occasionally (i.e., *sometimes*) or rarely in the English classroom. Usage involving higher-order learning (R1) and documentary production (R2) seldom took place, or in some instances, never occurred at all in the English classroom at the selected university.

Figure 3 also shows that items representing *Substitution* tend to cluster together to form a distinct category of widespread use, most likely due to their being low on the pedagogical complexity continuum, whereas items for the next three levels (*Augmentation, Modification,* and *Redefinition*) were more interspersed, occasionally intruding into adjacent levels and placing themselves in no distinct order or cluster. Surprisingly, *Augmentation* items turned out to be less prevalent than expected. The study had expected that the activities showing this second level would be reported more by the students since *Augmentation* is theoretically low in complexity in the SAMR hierarchy. As indicated in Figure 3, two *Augmentation* items placed themselves together with *Modification* and *Redefinition* items toward the lower end of English instructors' technology utilisation, suggesting a lack of use. The intrusion of items into adjacent categories or levels of technology usage is an interesting pattern that is expected to create some issue for the PAF analysis in the next section.

Underlying Factors of English Instructors' Usage of Digital Technology: PAF Results

After the descriptive examination, data from the 32 SAMR items were factor-analysed using Principal Axis Factoring (PAF) with Promax rotation. Promax was chosen over Varimax as the SAMR levels were conceived to be theoretically related. To finalise the results indicating the SAMR levels, the analysis examined the data's correlation matrix, sampling adequacy, communalities, eigenvalues, proportion of variance explained, and factor loadings. In addition to an eigenvalue of greater than 1, the analysis relied on the scree plot and factor interpretability to decide the number of underlying factors (i.e., the SAMR levels) to be retained. In the first run of analysis, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was .95, indicating the adequacy of the sample size for the application of PAF on the technology usage data. The degree of intercorrelation among the 32 items supported the use of PAF, with Bartlett's Sphericity Test being statistically significant, $\chi 2(496) = 5179.41$, $p = .001$.

However, the initial PAF results indicated the presence of three levels of technology usage (i.e., a three-factor structure), instead of the expected four levels, and explained 62% of the total variance extracted. The variance of the first factor, with the largest eigenvalue, was 17.29, while the eigenvalues of the second and third factors were 2.54 and 1.17, respectively. These results were also undermined by factorial complexity, as many items cross-loaded on more than one factor. For instance, 10 items loaded significantly on two or three factors. Another complexity concerned the loadings of eight items, which were neither statistically significant nor were they practically important, as they were below $\lambda = .50$ (taken as the threshold of a useful item). The most critical issue was the fact that the extracted number of factors did not match the theoretical expectation of the SAMR model, which postulates the presence of four distinct levels of technology usage.

These results were considered poor and unfitting, hence the PAF had to be revised, subsequently resulting in a series of revisions. In each revised procedure, every problematic item was identified and removed from the equation, one at a time. The process resulted in 16 items being removed from the extracted three-factor structure, finally settling for a two-factor measure of technology usage from the remaining 16 variables. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was .937, and the degree of intercorrelation among the remaining 16 items supported the use of PAF. The Bartlett's Sphericity Test was $\chi 2(120) = 2332.4$, $p = .001$, indicating that the overall correlation among the technology usage items was statistically significant. The revised PAF extracted two underlying factors of technology usage, explaining 61.7% of variance, with eigenvalues of 8.84 and 1.76. Table 4 shows the inter-item correlation matrix of the extracted data.

Table 4

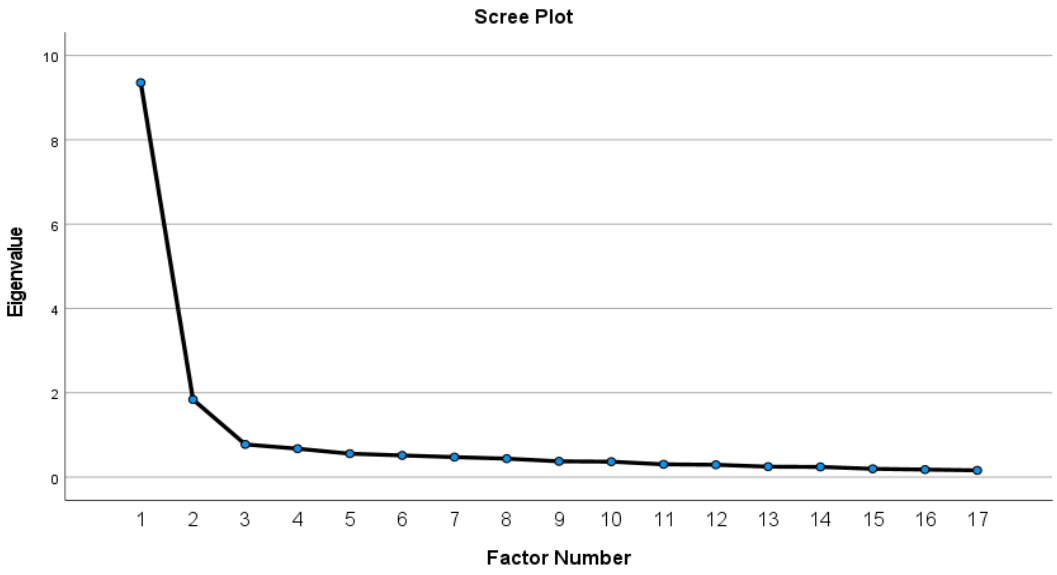
Correlation Matrix of the Extracted Items

Code	S1	S2	S3	S4	A1	A2	A3	A4	M1	M2	M3	M4	R1	R2	R3	R4
S1	1.00															
S2	0.53	1.00														
S3	0.58	0.70	1.00													
S4	0.57	0.54	0.68	1.00												
A1	0.47	0.52	0.51	0.47	1.00											
A2	0.34	0.37	0.27	0.31	0.62	1.00										
A3	0.40	0.51	0.53	0.46	0.59	0.56	1.00									
A4	0.30	0.29	0.25	0.33	0.47	0.56	0.46	1.00								
M1	0.39	0.46	0.42	0.42	0.63	0.60	0.56	0.51	1.00							
M2	0.42	0.41	0.36	0.44	0.60	0.67	0.49	0.65	0.70	1.00						
M3	0.49	0.50	0.51	0.47	0.56	0.54	0.63	0.42	0.58	0.58	1.00					
M4	0.47	0.37	0.40	0.48	0.60	0.62	0.56	0.56	0.71	0.68	0.72	1.00				
R1	0.49	0.42	0.50	0.52	0.63	0.57	0.47	0.49	0.66	0.61	0.64	0.74	1.00			
R2	0.36	0.27	0.26	0.34	0.50	0.58	0.44	0.54	0.59	0.65	0.47	0.64	0.64	1.00		
R3	0.38	0.36	0.36	0.34	0.58	0.57	0.57	0.47	0.70	0.66	0.59	0.66	0.62	0.64	1.00	
R4	0.36	0.27	0.30	0.40	0.55	0.56	0.49	0.58	0.65	0.68	0.55	0.68	0.61	0.71	0.75	1.00

However, the scree-plot (Figure 4) suggested the existence of more than two underlying factors, appearing to level off at the fourth factor. Theoretically, this indication was in keeping with the four levels of SAMR. Thus, the analysis decided to proceed with CFA to confirm the likelihood of a four-factor technology usage model as suggested by the scree plot.

Figure 4

Scree Plot Suggesting a Four-Factor Structure of English Instructors' Technology Usage



Testing a Four-Factor Technology Usage Model: CFA Results

Theoretically, the PAF results fell short of extracting a four-factor technology usage model that complied with the SAMR model. Hence, the study decided to run a confirmatory factor analysis (CFA) on the data, applying the maximum-likelihood (ML) estimation method using the AMOS 23 data fitting software. A four-factor technology usage model was first specified based on SAMR and three criteria of goodness of fit (GOF) were employed to determine the adequacy of the proposed model. The criteria were: (1) absolute fit; (2) incremental fit, and (3) parsimonious fit, each of which has its own fit indicators. The threshold values of the fit indices used in this analysis are summarised in Table 5.

Table 5

Goodness of Fit (GOF) Indicators

GOF Indicator	Name of Index	Threshold	Source
Absolute fit	Chi-square	*p* value > 0.05 (report if n is between 100 – 200)	Hair et al., (2013)
	RMSEA	≤ 0.08	Byrne (2010)
Incremental Fit	CFI	≥ 0.90	Hair et al. (2013)
	TLI	≥ 0.90	
Parsimonious Fit	ChiSq/df (Normed ChiSq)	≤ 5.0 (report if n > 200)	Hu & Bentler (1999)

Figure 5 shows the CFA results that confirmed the presence of four levels of technology usage as proposed in the SAMR model comprising *Substitution*, *Augmentation*, *Modification*, and *Redefinition*. The four sub-constructs were expected to be correlated and each item loaded only on its respective factor with uncorrelated error terms.

Figure 5

CFA Results Confirming a Four-Factor Technology Usage Model

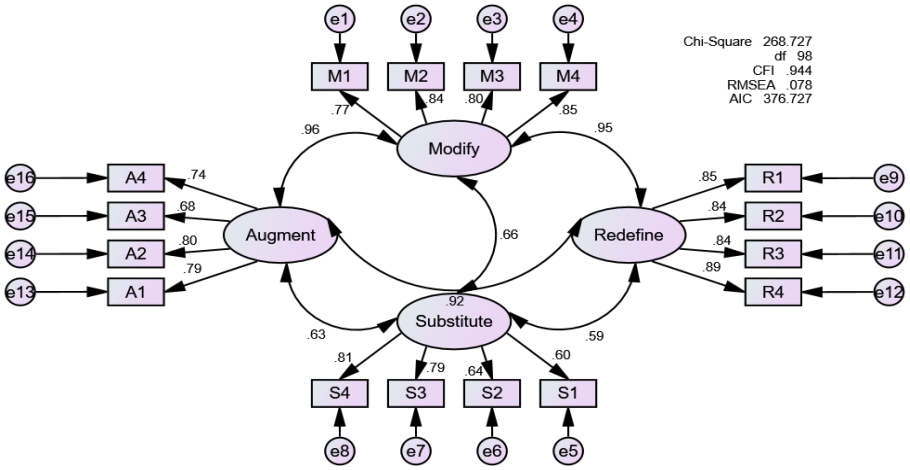


Figure 5 shows that the measure satisfied the requirements for a good fit model; $\chi 2(98) = 268.73$; $\chi 2/df = 2.74$; CFI = .94; RMSEA = .078, CI: .067, .090. These statistics confirmed the consistency of the proposed four-factor technology usage model with the data. All loadings were statistically significant (p =.001) and had practically important values ($\lambda \geq .5$). As expected, the four levels of English instructors' technology usage were positively correlated. Each factor was represented by four items, with all loadings exceeding the value of .68 (see Figure 5). Therefore, the CFA results supported the hierarchical structure of English instructors' technology usage conceived based on the SAMR model. Moreover, the empirical clustering of significant loadings on the factors perfectly matched the theoretical grouping of the questionnaire items. Table 6 shows the details of the CFA results.

Table 6

Descriptive Statistics, Alpha, Composite Reliability and Average Variance Extracted

Factor and Item		M	SD	Alpha	CR	AVE
Substitution				.80	.60	.51
S1	Using the textbook in softcopy rather than hardcopy *(originally S2)*	3.77	1.40			
S2	Using the projector to display information or notes *(originally S3)*	4.30	1.17			
S3	Using the LMS to assign homework *(S5)*	4.13	1.18			
S4	Using Blackboard instead of workbooks for review exercises *(S7)*	3.83	1.31			
Augmentation				.84	.64	.57
A1	Giving class feedback via the LMS *(retained)*	2.95	1.70			
A2	Creating video lessons and sharing them on class WhatsApp *(retained)*	3.43	1.51			
A3	Employing gamification apps (e.g., Kahoot & Quizizz) for language practice and assessment *(originally A5)*	3.47	1.55			
A4	Using translation apps (e.g., Google Translate) to help students understand words and phrases *(originally A6)*	2.92	1.59			

Table 6

(continued)

Factor and Item		M	SD	Alpha	CR	AVE
Modification				0.88	0.71	0.66
M1	Hyperlinking resources as feedback to students to encourage further learning *(retained)*	3.45	1.49			
M2	Using interactive navigation apps (e.g., Google Earth or Waze) to practise language items *(originally M5)*	2.94	1.58			
M3	Using digital platforms on students' smartphones to teach language skills *(M7)*	3.32	1.57			
M4	Using cloud tools (e.g., Google Docs, Padlet or Pinterest) to conduct collaborative learning activities *(M8)*	3.19	1.57			
Redefinition				0.92	0.76	0.73
R1	Having students synthesise their analytical thoughts using multimedia tools *(retained)*	3.19	1.53			
R2	Requiring students to create collaborative documentaries using multimedia *(retained)*	2.54	1.66			
R3	Requiring students to read online materials and annotate difficult words *(retained)*	3.04	1.63			
R4	Requiring students to screencast content explanation and share it for collaborative feedback *(retained)*	2.99	1.62			

The first extracted factor—with four strong and significant loadings—represents the use of technology as merely a substitution tool to replace a previous device or method of teaching. It is the most basic level of usage where good English lessons can still be conducted without the stated technology utilisation (i.e., using the overhead projector, the LMS and Blackboard and e-textbooks). These instructional activities constitute the indicators of technology integration at the *Substitution* level in SAMR.

The second factor has significant loadings on four items that share one common trait, that is, the technology is not being deployed just as a replacer of a previous device or instructional method. Instead, there is some functional change in the way it is used. For instance, the LMS is typically meant as a platform for uploading and sharing lecture materials, but when instructors use it to deliver feedback (*Item A1*) to improve student learning, the LMS use undergoes a substantive transformation from simple content sharing to a dynamic and interactive form of assessment for learning. Similarly for Item A4, translation apps (e.g., Google Translate and TripLingo) are primarily designed to facilitate communication but when they are used in learning a second language, the instructional activity experiences a significant pedagogical shift. Hence, these uses reflect the *Augmentation* level of technology utilisation in the SAMR model.

The third factor represents the *Modification* level, also with four indicator practices, such as *embedding feedback into hyperlinked resources to encourage further student learning* (M1) and *using navigation apps to practice language items* (M2). Technology integration at this level goes beyond simple substitution or enhancement activities and involves a significant redesign of the language learning tasks. The fourth factor comprises four items regarded as examples of *Redefinition*-level learning activities. These are activities rarely found in the English classroom, for instance, having students use multimedia and other technology tools to "*synthesise their analytical thoughts*" (R1), *"produce short collaborative documentaries*" (R2), *"read and annotate online materials"* (R3) and *"screencast content understanding"* (R4). Pedagogically, these activities are more challenging for instructors to integrate into classroom instruction, hence their placement in the highest level of SAMR.

DISCUSSION AND CONCLUSION

Digital technology in Saudi learning institutions is not only ubiquitous; it is also widely used. The LCD projector, for instance, is available in almost every classroom. Every school and university has an Internet connection with bandwidths that can meet the needs of a large number of users. The interactive whiteboard, according to Alghamdi and Higgins (2015, 2018), is an excellent teaching tool extensively utilised by Saudi teachers. The descriptive results of this study support these observations—that technology usage in Saudi classrooms is widespread and prevalent. Across all four SAMR levels, at least 30% technology usage was reported, indicating that at least one-third of the English instructors surveyed in this study did employ some form of technology to teach the language to their students. Some may have been hesitant users, but they are technology users, nonetheless.

However, much of instructors' technology usage centres around the *Substitution* level and tends to be rather basic and not pedagogically sound. This usage pattern corroborates the findings of Hammond and Gamlo (2015) who earlier reported that teachers' use of technology is restricted to basic or routine operations like using the LCD projector and PowerPoint slides to deliver content. They correctly wrote that "extended users" of technology is a minority, a case that has also been demonstrated in the results of the present study that found rare incidents of transformative technology use. Indeed, high levels of utilisation (i.e., at the *Modification* and *Redefinition* levels), ones that would transform learning and create a more galvanising learner experience, were rarely reported by the respondents in this research. This is

likely due to two factors that are generally lacking in university instructors, i.e., technology literacy and pedagogical content knowledge. To be able to use digital technology that can really transform learning and take student understanding to the next level, instructors need to first have the complete set of skills to handle the hardware and software involved. Technology competency is key. However, a recent systematic review of teachers' digital competency based on the results of 56 peer-reviewed publications concluded that teachers generally have a low or medium–low technology competency, asserting further that "despite having the resources to do so, [universities] still have a long way to go in terms of their digital competencies" (Basilotta-Gómez-Pablos et al., 2022, p. 12).

Second, instructors need to master the various pedagogical methods and strategies—from direct instruction to constructivist teaching to collaborative learning—to make their technology utilisation more nuanced and meaningful for student learning. Essentially, what this means is technology usage must be integrated with sound pedagogy—without adequate technological competency and appropriate knowledge of pedagogy, transformative technology usage cannot be achieved. Al-Shehri (2020) contended that the introduction of digital technology into English language instruction in Saudi learning institutions aimed to improve pedagogical practices in general and to empower students to be less teacher-dependent. In relation to this, while there is no evidence of the latter in this study—that students have become less dependent on teachers—there is, however, some evidence to suggest that instructors' pedagogical practices have remained largely unchanged, technology use notwithstanding. Merely using digital technology in teaching English does not mean a pedagogical paradigm shift has occurred in the English classroom.

The study has managed to confirm the hierarchical, four-level structure of instructors' digital technology usage as proposed by the SAMR model. The result of this exercise is a construct-valid instrument with 16 indicator practices that can justifiably be used to measure technology usage on a continuum. According to SAMR, technology use can occur at four distinct levels of pedagogical complexity, an idea supported by the data in this study. However, the process of arriving at the final, validated instrument was a laborious one, as half of the items created for the study could not be entered into the equation for a good-fitting model. Items like *"using MS Word features like track changes to highlight writing errors"* and *"using PowerPoint for a whole-class instruction*" did not make it into the validated model although they were good and clear statements reflecting tasks or activities commonly undertaken by teachers in the English classroom.

Creating indicator practices to capture English instructors' technology usage across the different pedagogical complexities of SAMR is not an easy undertaking, the reason being that technology integration does not always fit neatly into one category or level. Theoretically, the SAMR model represents a continuum of pedagogical transformation, and in practice, tasks or activities may exhibit the characteristics of multiple levels simultaneously or may be open to interpretation. For instance, a specific technology use might involve aspects of both *Augmentation* and *Modification*, making it challenging to categorise it strictly into one SAMR level. This inherent complexity and potential overlap among the SAMR levels or categories add to the difficulty of precisely assessing and categorising technology usage within the model. Nonetheless, the results have expanded our present understanding of the pedagogical nature of language instructors' use of technology in their teaching of English to Saudi learners. Additionally, they have contributed to the existing body of research literature aimed at a "pedagogical

revolution" in how university instructors use digital technology to teach students and foster authentic and meaningful learning (Collins & Halverson, 2018; Cunha et al., 2020; Tuma, 2021; Kohnke et al., 2023; Ng et al., 2023).

LIMITATIONS AND RECOMMENDATIONS

Two limitations constrain the study's results, the first of which concerns the measurement of the technology usage subconstructs as defined by the four SAMR levels. The items created might have overlapped as it was difficult to demarcate the distinct boundaries between the SAMR levels. It is not immediately clear as to where one level stops and the next level begins. Hence, it is likely that the items created for the study had contained some degree of ambiguity and overlapping characteristics, thereby influencing how the respondents had perceived and rated them. This had certainly influenced the quality of the data on which the PAF and CFA procedures were run. The second limitation arose from the sample—which was predominantly a male sample (94.4%). Given that males and females often have distinct perceptions of technology usage (Wiseman et al., 2018), especially in Saudi Arabia where gender differences are deeply rooted in cultural and traditional norms, there is a possibility that the results may be heavily skewed towards the male gender.

To improve the assessment of instructors' usage of digital technology, future studies should consider the following set of procedures in developing SAMR items. The first step is to create clear demarcations among the four levels and subsequently come up with distinct operational definitions of the levels based on the demarcations. Second, to create items that authentically reflect actual classroom usage of technology, direct classroom observations should be conducted. These observations should encompass English lessons across the skills of listening, reading, speaking and writing that utilise digital technology taught by teachers with varying levels of technological competency and pedagogical efficacy. The observation data can provide a more accurate depiction of instructors' technology usage and a contextually rich foundation for the development of SAMR survey items. The final step entails engaging English instructors in dialogues about technology integration into classroom learning based on the SAMR levels. These procedures are systematic and can be expected to produce comprehensive and well-validated SAMR items for future research on digital technology usage among English language instructors in Saudi higher education—and beyond.

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