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Exploring the Effects of Excessive Texting Through Mobile Applications on Students' Technostress and Academic Writing Skills in the Arabic Language

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ABSTRACT This study aims to develop a model to examine the influence of excessive mobile application (app) texting on technostress and academic writing skills in the Arabic language among undergraduates in higher education. In this study, the person-technology (P-T) fit model was used as a means of exploring the effect of excessive mobile app texting on students' levels of technostress and the influence of these factors on their academic writing skills. The sample was comprised of 235 undergraduate students who were selected by random sampling. The study proposed a model comprised of several factors that assist in answering the study questions. These factors are the following: 'excessive mobile apps texting', 'techno-overload', 'techno-invasion', 'techno-complexity', 'accuracy', 'clarity', 'cohesiveness', and 'vocabulary'. A developed questionnaire was employed as the main data collection method to obtain relevant information regarding excessive mobile app texting, mobile technostress, and students' academic writing skills. A quantitative research method via structural equation modeling (SEM) was used to analyze the data. The results showed that excessive mobile app texting and mobile technostress, including techno-overload, techno-invasion, and techno-complexity, have negative influences (through both direct and indirect effects) on students' academic writing skills, including accuracy, clarity, cohesiveness, and vocabulary. Several pedagogical and technical implications are suggested at the end of this study.

INDEX TERMS Academic writing skills, excessive texting, higher education, Arabic language, mobile apps, structural equation modeling (SEM).

I. INTRODUCTION

Mobile technology has been positioned as an essential communication tool for facilitating teaching and learning, particularly in tertiary education [1]–[3], [4]. Mobile devices are owned by 99.8% of college students in US, according to Post [5]. In the Middle East, 72% of young adults under the age of 34 own mobile devices [6], and, according to Taleb *et al.* [7], the Middle East region is expected become the second-largest population of mobile device users in the world. In 2014, Saudi Arabia had the third-highest prevalence of mobile device users in the region with 60% after Qatar (75%) and the UAE (73%) [6]. Therefore, the teaching and learning practices in higher education institutions have dramatically changed as the usage of mobile technology has increased among adult learners [8] in Saudi Arabia [7], [9]. Today, numerous mobile applications (apps) have been made available for teachers to employ in their teaching practices. In their study, Al-Hashemi and Al-Azzawi [10] noted that teachers increasingly utilize writing via mobile apps to organize extracurricular activities, and this is considered a form of written communication related to contemporary technology [11], [12]. Writing via mobile apps is usually referred to as "texting" in the mobile learning literature [11], [13], [14]. Through mobile apps, students use texting to communicate in various academic settings (e.g., learning tasks, projects, assignments, instructor and peer discussions, and exams). Given that, the written language used in texting must be

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accurate and understandable to achieve the learning purposes. This requires students to possess academic writing skills that ensure appropriate communication and therefore effective learning interaction [15], [16].

However, to what extent do undergraduates actually practice these skills while texting through mobile apps? This is particularly important with the surge in mobile device ownership [2] and the associated level of excessive usage [9], [17], [18] among undergraduates. Excessive usage is also described as compulsive usage or overreliance on technology [19]. Excessive refers to the high level of constant usage of mobile apps that are associated with anxiety and stress [20]–[23]. Several studies have shown that the use of mobile technologies (e.g. social apps) has a negative impact on students' behaviors and attitudes [9], [20], [24]. For example, Saleem and Bakhsh [25] and Shafie *et al.* [26] have warned that the excessive use of mobile texting has a negative influence on students' formal writing skills. Moreover, the level of mobile device usage has been found to negatively impact technostress among students [2], [24], which adversely affects students' performance [1], [9]. The increase in mobile device texting by undergraduates and the importance of maintaining academic writing skills for better learning performance have triggered the interest to investigate the influence of excessive mobile texting on students' academic writing skills in the Arabic language, and how the existence of technostress also influences this process. In summation, the present study intends to contribute to the literature by examining the impact of students' excessive texting through mobile apps on both their academic writing skills and the development of technostress. Therefore, this study aims to address the following research questions.

(1) What is the relationship between students' excessive texting through mobile apps and students' academic writing skills in the Arabic language in Saudi Arabia?

(2) What is the relationship between students' excessive texting in the Arabic language through mobile apps and students' mobile technostress levels in Saudi Arabia?

(3) What is the relationship between mobile technostress and students' academic writing skills in the Arabic language in Saudi Arabia?

II. PERSON-TECHNOLOGY (P-T) FIT MODEL

Since the purpose of this study was to explore the effects of excessive mobile app texting on students' academic writing skills while also considering the influence of technostress on this relationship, this study was conducted through the theoretical lens of the person-technology fit model (P-T fit model) [27]. The P-T fit model demonstrates that behavioral strains and anxiety, including negative self-evaluations, depression, and exhaustion, reduce students' productivity and account for poor task performance [2, p. 1341]. The P-T fit model (shown in Fig. 1) is among the first to provide insight into how the characteristics of technology influence stressors (with the process being captured by the idea of technostress creators) [2]. The P-T fit model includes three main

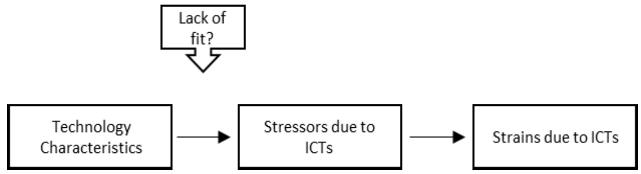

FIGURE 1. Person-technology (P-T) fit model [27].

components: "technology characteristics," "stressors," and "strain." Technology characteristics refer to the attributes or features of a particular technology application (we specify them as mobile app features in this study). Stressors represent the factors or conditions that create stress (referred to as technostress in this study). Strain refers to the behavioral or psychological consequences of stress that are observed in individuals [28]. Psychological strains are emotional reactions to stressor conditions, which may include exhaustion and depression, whereas behavioral strains involve reduced productivity and poor task performance [27], [29]. The present study mainly discusses the behavioral strains (academic writing) that mobile apps bring to students.

In academic settings, several gaps have been identified in the literature of mobile texting and writing skills. First, the literature on the effects of texting through mobile apps has extensively discussed the negative influence of mobile app texting on academic writing skills [11], [12], [14], [25]; however, the negative effect of technostress, as an influential factor in this process, has not been investigated. Second, from a theoretical perspective, there has been little attention paid by educational researchers to the use of the P-T fit model to understand the causes of students' technostress [2], [30]. This study intends to fill in the foregoing research gaps. It extends the related literature on students' mobile app use via excessive texting to a more focused look at the impacts on academic writing skills in a higher education context. It also applies the P-T fit model (as a theoretical lens) to explore the antecedents and consequences of technostress when students write through mobile apps for academic purposes.

III. RESEARCH MODEL AND HYPOTHESES

Based on the P-T fit model, this study examines the relationships between the excessive mobile app texting (EMAT) and mobile technostress (MTS), and their influence on students' academic writing skills (AWRS). These relationships were proposed in a conceptual model shown in Fig. 2. In Fig. 2, EMAT is related to the technology characteristics in the P-T fit model. Meanwhile, MTS (stressors) mediates the relationship between the EMAT and the AWRS (strains). Accordingly, the three main latent variables included in the conceptual framework (Fig. 2) are divided into three types: EMAT as an independent variable, MTS as a mediate variable, and AWRS as a dependent variable. The three observed variables MTS1, MTS2, and MTS3 are indicators of the latent variable MTS, and the four observed variables AWRS1, AWRS2, AWRS3, and AWRS4 are indicators of the latent variable AWRS. The present study reveals that EMAT and

MTS are associated with AWRS. The rest of this section discusses the literature supporting the proposed three hypotheses of this study.

Technostress is a term used frequently to describe the challenges that people face while using technology [2], [18], [29], [31]. Hsiao *et al.*'s [1] findings have indicated that compulsive use of mobile apps contributes to technostress among users. Since mobile devices are presently the most common communication tools, undergraduate students have no choice but to use them for personal and academic purposes [24], [32]. Students may check their networking apps constantly, even when it is unnecessary, and develop anxiety whenever they are unable to reply to messages or post comments [17], [18], [30]. Therefore, students who cannot control their usage of social apps can experience a high degree of stress [2], [33]. Therefore, the first hypothesis is proposed:

H1: Students' excessive mobile app texting (EMAT) in the Arabic language is positively associated with mobile technostress (MTS) in Saudi Arabia.

The level of language proficiency greatly affects the level of communication, and hence the efficiency of student achievement, which is a prerequisite for all disciplines [15], [16], [34]. For example, when students are asked to participate in learning activities (e.g., contribute to a discussion thread via Wiki, demonstrate ideas via MindMeister, or answered questions via Poll Everywhere) using their mobile devices, their ability to write text in a clear and sound language determine the quality of the feedback obtained and thus their learning performance. There are essential writing skills that students must acquire in order to master academic writing, the most important of which are the following: (1) considering the rules of spelling and grammar; (2) presenting ideas clearly, accurately, and thoroughly; (3) using appropriate punctuation and linking words; and (4) using appropriate vocabulary to express ideas and thoughts in a comprehensive and cohesive manner [35]–[37]. However, the use of mobile apps has been associated with an undesirable impact on academic writing skills [14], [25], [38]. A study by Yousaf and Ahmed [12] examined the factors contributing to the development of university students' writing skills in Pakistan, and they found that mobile texting harms academic writing skills, as 40% of them indicated that they sent and received from 100 to 200 messages on a typical day for learning purposes. Another study by [25] observed that students unintentionally fail to pay attention to their spelling when texting using mobile devices. Moreover, the excessive use of mobile apps is leading students to use unstandardized short abbreviations and incorrect spellings [12], [39], poor punctuation and grammatical errors [13]. In a study of the influence of mobile texting language on Saudi students' academic writing, Alharbi [40] indicated that students always make spelling and sentence construction errors in formal writing due to their overreliance on the language used on mobile texting apps.

Therefore, the second hypothesis is proposed:

H2: Students' excessive mobile app texting (EMAT) is negatively associated with the development of their academic writing skills (AWRS) in the Arabic language in Saudi Arabia.

Despite the capabilities offered by mobile technologies that provide convenient learning (anytime and anywhere) [41], the technostress caused by excessive usage affects students' productivity and academic performance [9], [12], [27], [29]. When using technologies, the 'helpful-stressful cycle', as described by Lee *et al.* [42], is always associated with several factors. One of these factors is that technologies are becoming more sophisticated and, at times, difficult to use [43]. According to [44], techno-complexity is one of the technostress creators affecting individuals' ability to efficiently use technologies. Students may experience frustrations due to their inadequate technological skills for operating mobile technologies. Given that, if students intensively use mobile texting to communicate for learning purposes, their ability to understand and operate the various functionalities of mobile apps determine the quality of their texting (writing). Another factor associated with technostress is the overwhelming amount of information and the multitasks that students need to work with, which is referred to as techno-overload [44]. Thus, "when faced with tremendous information, students are forced to work faster to cope with increased and real-time processing requirements from instructors and groupmates" [2, p. 1343]. In addition, students' academic tasks have overlapped their own time, which has caused even more stress and anxiety [1], [17], [18], [29]. Then, the advantage of technology is turned into techno-invasion [44] in a way since they are forced to use texting through mobile apps in their own time. These types of technostress may cause students to ignore academic writing rules that can hamper their writing skill development. That made ungraduated students' time full of complexity, anxiety and stress. Based on the above discussion, the third hypothesis is proposed:

H3: Students' mobile technostress (MTS) is negatively associated with the development of their academic writing skills (AWRS) in the Arabic language in Saudi Arabia.

IV. RESEARCH METHODOLOGY

A. SAMPLE CHARACTERISTICS

The aim of this study is to examine a proposed conceptual model articulating the relationship between EMAT and students' MTS and their AWRS. There were 235 undergraduate students participating in this study. According to [45, p. 462], "the appropriate sample size should not be less than the number of variables multiplied by 20". Since this study has eight variables (EMAT, MTS1, MTS2, MTS3, AWRS1, AWRS2, AWRS3, and AWRS4), the sample size of 235 ($8 \times 20 = 160 < 235$) is more than sufficient for the current study.

The student participants were male and female undergraduates from various age groups. They represented various colleges, such as Education, Computer Sciences, Applied Medical Sciences, Art, Business, Law, Agriculture, Science, and Engineering.

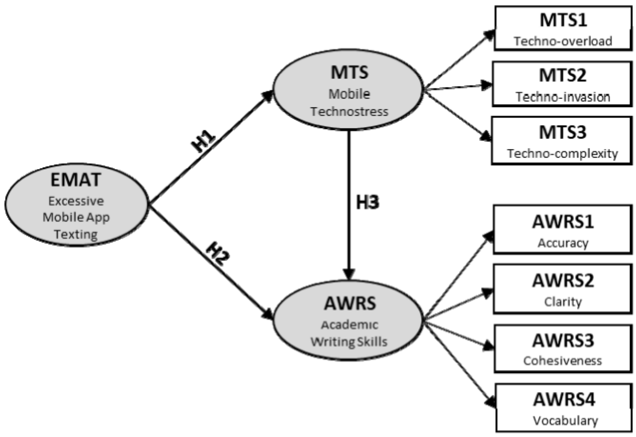

FIGURE 2. Conceptual framework.

B. DATA COLLECTION AND MEASUREMENT

The data were collected during the second semester of the 2020 academic year at King Faisal University in Saudi Arabia. After ethical approval was obtained, a self-reported survey questionnaire was electronically distributed for university students via their emails. The data were collected during the second semester of the 2020 academic year at King Faisal University in Saudi Arabia. After ethical approval was obtained, a self-reported survey questionnaire was electronically distributed to university students via email. The survey questionnaires were sent to a random sample of four hundred male and female students (200 each), the questionnaire was available on line for 3 weeks. Two hundred and fifty-eight students agreed to participant and completed the survey. Nighty-one percent (n = 235) of the participants described their texting through mobile apps as 'considerable' or 'excessive' while 9% (n = 23) indicated that they 'sometimes' texted through mobile apps or described their texting as 'average'. As this study focused on excessive texting, the responses of those 23 participants were excluded from the study sample.

The survey questionnaire (shown in the Appendix) was comprised of 32 items measured on a 5-point Likert scale including 1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = agree, and 5 = strongly agree. The survey questionnaire was comprised of two sections. The first section was developed to collect demographic information from the participants, such as their gender, age, College and the extent to which they used mobile apps for texting. The second section covered the following factors. First, there was a section on EMAT comprised of six items, as influenced by the work of Cheon *et al.* [3]. In this study context, EMAT refers to students using the texting feature of any type of mobile app addictively for learning purposes (e.g., tasks, assignments, projects, discussion, or interaction with peers and instructors). This is similar to the structure adopted by Cheon *et al.* [3] in their study that highlighted several learning settings that undergraduate students experienced utilizing mobile devices. Therefore, the current study adopted the learning settings suggested by Cheon *et al.* [3] and asked students to rate their perceptions in terms of to what extent they used the texting feature of mobile apps in learning settings.

The second factor of the second part of the questionnaire survey addressed the issue of MTS, consisting of questions on three concepts as follows: techno-overload (five items), techno-invasion (four items), and techno-complexity (five items). All of these were adapted from the work of Tarafdar *et al.* [44]. Techno-overload refers to the situations where technology (mobile apps) forces students to work (by texting) faster and longer under the pressure of accomplishing academic tasks. Techno-invasion refers to the disturbing effect of technology (mobile apps) where students are constantly connected and are available at anytime and anywhere, resulting in an overlap between students' personal lives and their academic obligations. Techno-complexity means that technology imposes difficulties on students when they are keeping abreast of the emerging mobile apps and their inherent complexity that requires students to spend time and effort to learn how to use (and text through) these new mobile apps.

The third factor covered by the second part of the survey questionnaire was AWRS, which was comprised of four categories as follows: accuracy (two items), clarity (three items), cohesiveness (three items), and vocabulary (four items). All of these were adapted from Ashour and Megdadi [35]. Accuracy describes students' writing skills in terms of grammar and spelling in the Arabic language. Clarity focuses on students' writing skills and their ability to clarify main ideas while also being able to organize subideas in a logical and flawless style. Cohesiveness describes students' writing skills in effectively using linking words, punctuation and appropriate phrase sequencing. Vocabulary refers to students' abilities to use appropriate expressions with their intended meanings, the use of simple and complex words, and the proper use of abbreviations and symbols.

C. RELIABILITY AND VALIDITY OF THE INSTRUMENT

SPSS (v. 18) was used to measure the reliability and validity of this study instrument on a pilot sample of 150 student participants. As shown in Table 1, the instrument consisted of three main variables (EMAT, MTS, and AWRS) and seven subvariables (MTS1, MTS2, MTS3, AWRS1, AWRS2, AWRS3, and AWRS4).

All Cronbach's alpha coefficients for each subvariable when deleting any of its items were less than the alpha coefficient for the variable if all of its items exist, that is, the existence of any of its items does not decrease the total Cronbach's alpha coefficients of the dimension, and this indicated that each item has a reasonable contribution to the overall reliability of the variable measured by the item [45]. All correlation coefficients with the total degree of the variable (Item-Total Correlation) were statistically significant (α = 0.01), which indicated the internal consistency and reliability of all the instrument's items. The overall Cronbach's alpha of the three research variables, EMAT (0.77), MTS (0.82), and AWRS (0.85), were high and acceptable. All correlation

TABLE 1. Reliability and validity coefficients of the study's instrument (N = 150).

Item	Cronbach's Alpha if Item Deleted	Item-Total Correlation	Corrected Item-Total Correlation	Cronbach's Alpha of Variable
EMAT1	0.716	0.73**	0.61**	0.773
EMAT2	0.728	0.69**	0.57**	
EMAT3	0.758	0.60**	0.44**	
EMAT4	0.754	0.67**	0.48**	
EMAT5	0.741	0.68**	0.51**	
EMAT6	0.735	0.70**	0.53**	
Cronbach's Alpha of total EMAT (6 Items) = 0.773				
MTS1.1	0.757	0.64**	0.45**	0.770
MTS1.2	0.737	0.70**	0.51**	
MTS1.3	0.744	0.67**	0.49**	
MTS1.4	0.663	0.84**	0.71**	
MTS1.5	0.727	0.75**	0.55**	
MTS2.1	0.684	0.77**	0.57**	0.753
MTS2.2	0.698	0.75**	0.54**	
MTS2.3	0.680	0.77**	0.58**	
MTS2.4	0.719	0.74**	0.51**	
MTS3.1	0.813	0.71**	0.53**	0.821
MTS3.2	0.770	0.80**	0.67**	
MTS3.3	0.765	0.81**	0.69**	
MTS3.4	0.790	0.76**	0.60**	
MTS3.5	0.791	0.74**	0.60**	
Cronbach's Alpha of total MTS (14 Items) = 0.825				
AWRS1.1		0.89**	0.54**	0.697
AWRS1.2		0.86**	0.54**	
AWRS2.1	0.749	0.74**	0.48**	0.754
AWRS2.2	0.604	0.85**	0.64**	
AWRS2.3	0.602	0.85**	0.64**	
AWRS3.1	0.677	0.86**	0.66**	0.787
AWRS3.2	0.678	0.84**	0.66**	
AWRS3.3	0.775	0.81**	0.57**	
AWRS4.1	0.701	0.72**	0.48**	0.736
AWRS4.2	0.706	0.72**	0.48**	
AWRS4.3	0.619	0.80**	0.64**	
AWRS4.4	0.680	0.76**	0.52**	
Cronbach's Alpha of total AWRS (12 Items) = 0.855				

** Sig. at (α =0.01)

coefficients with the total degree of the variable if the item score is omitted from the total score of the variable it measures (Corrected Item-Total Correlation) were statistically significant (α = 0.01), which indicated the validity of all instrument's items.

The factorial validity of the study instrument was calculated by using the confirmatory factor analysis (CFA) to confirm the validity of the latent structure of the instrument. The model of the three latent factors (EMAT, MTS, AWRS) was tested on the pilot sample (n = 150), and in this model it was assumed that the 8 observed variables (EMAT1, MTS1, MTS2, MTS3, AWRS1, AWRS2, AWRS3, AWRS4) are loading with the three latent factors. The three latent factors had a good Goodness of Fit Indices, as shown in Table 2, where the value of chi-square is not statistically significant, and the values of all indices fell within the acceptable range for each index, this indicates a good fit of the model with the data being tested [46].

It is clear from Table 3 that all loadings or validity coefficients are statistically significant at (0.01) level, which indicates the validity of all factors of the research instrument That is, the CFA provided strong evidence for the validity of the underlying structure of this scale, and that the eight observed factors make up three latent factors (EMAT, MTS, AWRS).

TABLE 2. Goodness of fit indices for CFA model (n = 150).

No	Index	Value	Acceptance Range of Index	Best Value of Index
1	Chi-Square X^2 df P (Sg.)	21.14 17 0.22	X^2 is not statistically significant	0
2	X^2 / df	1.24	(0) to (5)	0
3	Goodness of Fit Index (GFI)	0.97	(0) to (1)	1
4	Adjusted Goodness of Fit Index (AGFI)	0.93	(0) to (1)	1
5	Root Mean Square Residual (RMR)	0.06	(0) to (0.1)	0
6	Root Mean Square Error of Approximation (RMSEA)	0.04	(0) to (0.1)	0
7	Expected Cross-Validation Index (ECVI) for CFA Model ECVI for Saturated Model	0.40 0.48	(ECVI) for Causal Model ≤ ECVI for Saturated Model	
8	Normed Fit Index (NFI)	0.93	(0) to (1)	1
9	Comparative Fit Index (CFI)	0.98	(0) to (1)	1
10	Relative Fit Index (RFI)	0.88	(0) to (1)	1
11	Incremental Fit Index (IFI)	0.99	(0) to (1)	1

TABLE 3. Loadings of observed variables with three latent factors (N = 150).

Latent Variable	No	Observed Variable	loading	Standard Error of Loading Estimate	T-Value	Sig.
EMAT	1	EMAT1	1.00	0.058	17.26	0.01
MTS	2	MTS1	0.63	0.117	5.38	0.01
	3	MTS2	0.49	0.106	4.58	0.01
	4	MTS3	0.58	0.113	5.15	0.01
AWRS	5	AWRS1	0.58	0.083	7.00	0.01
	6	AWRS2	0.84	0.081	10.39	0.01
	7	AWRS3	0.78	0.081	9.65	0.01
	8	AWRS4	0.40	0.091	4.36	0.01

V. RESULTS AND DISCUSSION

The student participants were invited to complete an electronic-based questionnaire to reflect on their perceptions and experiences of excessive mobile app use for texting and their associated technostress, along with the apparent effects of these factors on their AWRS. The vast majority of respondents were female students (96.4%), and very few male students (3.6%) participated in this study. Most of the participants were from an average age group of 18–22 years old (75.4%). The remainder of the participants fell between the ages of 23–26 years old (17%) or more than 26 years old (6.9%), and only 0.4% were less than 18 years old. They were from various colleges such as Education (60.1%), Computer Sciences (15.6%), Applied Medical Sciences (7.2%), Art (6.9%), Business (2.9%), Law (1.8%), Agriculture (1.4%), Science (1.1%), and Engineering (0.7%).

A. MEASUREMENT MODEL ANALYSIS

Structural equation Modeling (SEM) was implemented as the main statistical technique to analyze the data with CFA. SEM was applied to investigate the direction and strength of the relationships between the conceptual model variables. The validity coefficient of the observed variables

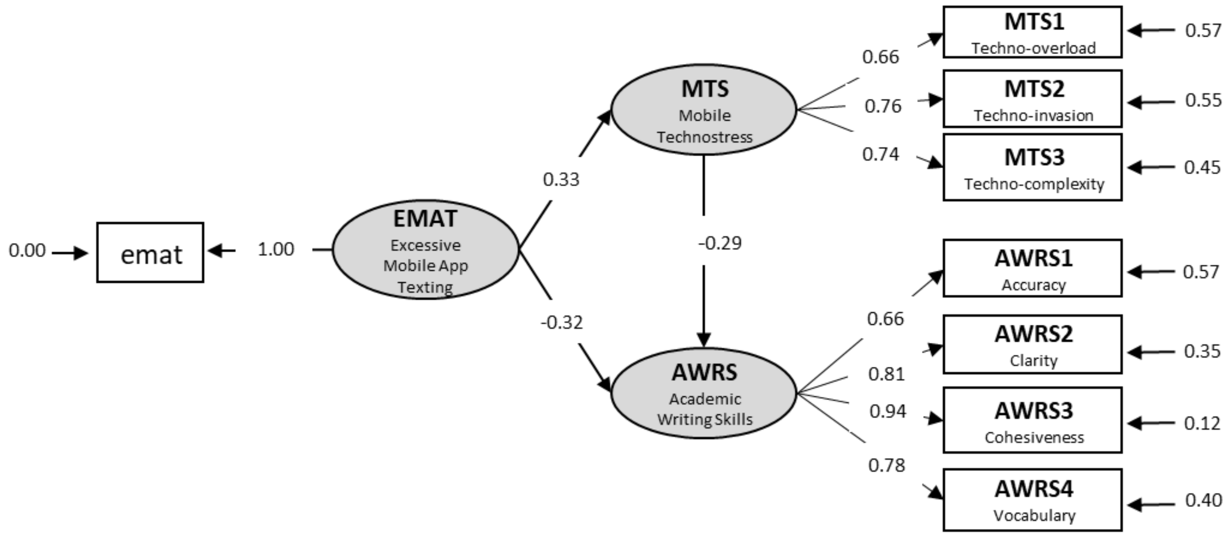

FIGURE 3. Structural equation modeling (causal model).

TABLE 4. Goodness of fit statistics for the causal model (n = 235).

No	Index	Value	Acceptance Range of Index	Best Value of Index
1	Chi-square X^2 df P (Sg.)	23.41 15 0.08	X^2 is not statistically significant	0
2	X^2/df	1.56	(0) to (5)	0
3	Goodness of Fit Index (GFI)	0.98	(0) to (1)	1
4	Adjusted Goodness of Fit Index (AGFI)	0.94	(0) to (1)	1
5	Root Mean Square Residual (RMR)	0.04	(0) to (0.1)	0
6	Root Mean Square Error of Approximation (RMSEA)	0.05	(0) to (0.1)	0
7	Expected Cross-Validation Index (ECVI) for Causal Model ECVI for Saturated Model	0.28 0.31	(ECVI) for Causal Model ≤ ECVI for Saturated Model	
8	Normed Fit Index (NFI)	0.98	(0) to (1)	1
9	Comparative Fit Index (CFI)	0.99	(0) to (1)	1
10	Relative Fit Index (RFI)	0.96	(0) to (1)	1
11	Incremental Fit Index (IFI)	0.99	(0) to (1)	1

ranged from (0.66) to (0.74) for the MTS latent variable and from (0.66) to (0.94) for the AWRS latent variable. To obtain the causal model that illustrates the effects (direct and indirect) among the current study's theoretical constructs, which are included in the conceptual model illustrated in Fig. 2, the SEM method available in the LISREL 8.8 program was used. The overall goodness of fit was assessed using fit indices (X2, df, X2/df, RMR, IFI, CFI, and RMSEA).

The results of the LISREL 8.8 program indicated that the SEM (causal model) shown in Fig. 3 had strong goodness of fit indicators, as shown in Table 4, where the value of the X2 is not statistically significant, and the values of all indicators fell within the acceptable range for each indicator; this indicates a good fit for the model with the data being tested [46, pp. 370–371].

B. STRUCTURAL MODEL ANALYSIS

CFA was conducted as a second step in the SEM. It can be seen from Table 1 that the key statistics of the conceptual model are very strong. Therefore, the conceptual model of this study is valid, and the results of the hypotheses should be analyzed.

Fig. 3 shows that the validity coefficients of the three observed variables (MTS1, MTS2, and MTS3) for the latent variable MTS were 0.66, 0.76, and 0.74, respectively, which are high coefficients and indicate the validity of the observed variables of the latent variable MTS. The validity coefficients of the four observed variables (AWRS1, AWRS2, AWRS3, and AWRS4) for the latent variable AWRS were 0.66, 0.81, 0.94, and 0.78, respectively, which are high coefficients and indicate the validity of the observed variables of the latent variable AWRS [46, p. 120].

C. RESULTS OF THE HYPOTHESES

This study aimed at developing a model to examine the influence of EMAT on AWRS in the Arabic language among undergraduates in higher education through the P-T fit model. The data analysis results support the three hypotheses in this study model and reveal some interesting findings. Table 5 shows the direct, indirect, and total effects included in the SEM (causal model), combined with the T-values and standard error of the effect estimate along with the statistical significance of the effect.

From Fig. 3 and Table 5, structural equations can be formulated in the following forms:

$$\text{MTS} = 0.33^{*}\text{EMAT}, \quad R^2 = 0.110$$
$$\text{AWRS} = -0.29^{*}\text{MTS} - 0.32^{*}\text{EMAT}, \quad R^2 = 0.245$$

The multiple correlation coefficients of the previous structural equations were 0.110 and 0.245, respectively. These are relatively high coefficients, indicating the relatively high

TABLE 5. The direct, indirect, and total effects included in the SEM (n = 235).

Affected Variables	Kind of Effect		Influencing Variables: Excessive mobile app texting (EMAT)	Influencing Variables: Mobile technostress (MTS)
Mobile technostress (MTS)	Direct	Effect	0.33	
		Sd. Error	0.09	
		T Value	3.73**	
	Total	Effect	0.33	
		Sd. Error	0.09	
		T Value	3.73**	
Academic writing skills (AWRS)	Direct	Effect	- 0.32	- 0.29
		Sd. Error	0.07	0.09
		T Value	4.53**	3.31**
	Indirect	Effect	- 0.09	
		Sd. Error	0.03	
		T Value	2.97**	
	Total	Effect	- 0.41	- 0.29
		Sd. Error	0.07	0.09
		T Value	5.69**	3.31**

Sd. Error = Standard error of the estimate
** Statistically significant ($p \leq 0.01$).
If 1.96 ≥ T Value > 2.58 then the result is statistically significant at $p \leq 0.05$.
If 2.58 ≤ T Value, then the result is statistically significant at $p < 0.01$.

level of practical significance of the construction described in these structural equations. The following section contains the results and a discussion for each hypothesis.

First, Table 5 shows that there are statistically significant direct and positive effects ($\beta 1 = 0.33$, $t = 3.73$, and $p > 0.01$) of EMAT on MTS. This means that EMAT significantly influences the MTS creators in a direct way. These results indicate the acceptance of the first hypothesis (H1), which implies that students are stressed by mobile app technology when texting for academic purposes. Therefore, the techno-overload, techno-invasion, and techno-complexity that individuals usually encounter when utilizing technology do apply to university students when texting via mobile apps in an academic context. This result is consistent with the related literature on technostress [27], [29] and the P-T fit model. It is also in line with a number of related studies [1], [2]. Several possible explanations for this result are as follows. First, these effects may be due to the current increase in the use of mobile learning by university instructors, which largely corresponds to the characteristics of university students in the 21st century. At the present time, students need flexible learning materials that enable them to access a course's contents and materials in order to accomplish learning tasks at anytime and anywhere, and obtain immediate and continuous feedback [1], [3], [23]. This has all led to the presence and the development of great pressure, which is leading to a growing and overwhelming struggle among students due to the excessive use of mobile apps to communicate (texting) and accomplish their learning tasks [47].

In addition, the academic and administrative workload on instructors has increased, which forces them to structure a large part of the teaching process through informal communication means, and mostly through mobile apps, such as social apps (WhatsApp, Telegram, Twitter, etc.). Additionally, modern teaching methods such as flipped classes and blended learning have also pushed a large portion of the teaching and learning process onto the internet (and, more specifically, mobile apps) [8], [15], [32], [37]. All of these developments are represented by corresponding changes in technological overload and technological invasion [2]. Consequently, students are forced to use mobile apps excessively, especially in their personal time (outside of the classroom) [9]. Students perform learning tasks outside the classroom (online) in an amount of time that far exceeds the time it takes to perform their learning tasks in the classroom [17], [18]. In addition, an instructor's use of mobile technologies in the classroom has created a great pressure on students in terms of adapting to various and complex technological applications, which are utilized differently by different instructors for various learning purposes [2], [27], [30], [44].

Second, there are statistically significant direct and indirect negative effects ($\beta 2 = 0.41$, $t = 5.69$, and $p > 0.01$) of EMAT on AWRS. This means that the more frequent the engagement in EMAT is, the lower the AWRS, in both direct and indirect ways. Since the indirect effect of EMAT on academic writing skills is brought about by the mediator variable "mobile technostress," these results indicate the acceptance of the second hypothesis (H2), which states that EMAT has a negative effect on AWRS. This result is in line with prior educational research related to mobile app texting and AWRS [7], [26], [35]. Moreover, this study result confirms the negative effect of EMAT on AWRS. This particular result is consistent with students' perceptions in this study. The majority of students indicated their agreement with using the texting method in an excessive manner when engaging in several learning practices such as communicating with instructors (85%), discussing course materials and assessment with peers (92%), collaborating on learning assignments and projects (96%), and making general academic and learning enquiries (86%). This means that AWRS is mostly affected by students' excessive mobile texting when they communicate and collaborate with their peers regarding course materials, assessments, and projects. This excessive texting via mobile apps might be due to the lack of clarity regarding course objectives, content, learning outcomes, requirements, and assessments. As a result, students tend to frequently use texting via mobile apps to get further clarification regarding their courses. Therefore, instructors should carefully pay attention to how they can provide students with clear and precise course instructions and details at the beginning of the semester.

Third, there are statistically significant direct and total negative effects ($\beta 3 = 0.29$, $t = 3.31$, and $p > 0.01$) of mobile technostress creators (mobile apps) on AWRS. In general, these results indicate the acceptance of the third hypothesis (H3), which states that the mobile technostress creators (mobile apps) impair students' AWRS. These findings indicate that the relationship between the stressors (mobile apps) and strain (AWRS) is supported by the P-T fit model literature, which confirms that stressors are caused by individuals' technological lack of fit that results in negative behavioral and psychological consequences [2]. These findings are also supported by a number of empirical studies highlighting the negative impact of technostress on individual performance [1], [27], [29], [42]. As shown in Fig. 3, techno-invasion and techno-complexity are the two most dominant types of stressors contributing to weakening of the AWRS of university students. This means that the majority of stress caused by EMAT (leading to weak AWRS) arises due to situations in which students constantly text via mobile apps in their personal lives (home time) and when mobile apps are too complicated for them to learn (students spend time and effort to learn how to use them, and therefore they text). Regarding the specific skill of academic writing that was shown to be affected by technostress in this study, Fig. 3 shows that clarity and cohesiveness are the most negatively affected by technostress caused by EMAT while grammatical accuracy and use of vocabulary are less affected by the technostress caused by EMAT. This means that when students text via mobile apps, they do not pay attention to articulating the main ideas clearly. Furthermore, they do not organize the texted ideas in an understandable manner. Likewise, students do not appropriately use linking tools and punctuation, nor do they present their ideas in an acceptable or logical sequence when texting through mobile apps. This is confirmed by the results in Table 6, where the correlation is found to be highly significant between the two AWRSs of clarity and cohesiveness.

Table 6 shows that the correlation among all of the independent variable as observed through the mediator and dependent variables is statistically significant ($p > 0.01$), except for one correlation coefficient. The largest correlation coefficient was found between clarity and cohesiveness ($r = 0.\ 761$) while the lowest correlation coefficient was found between techno-overload and clarity ($r = -0.125$), which supports the other results of this study.

TABLE 6. Correlation matrix between search variables (n = 235).

	EMAT	MTS1	MTS2	MTS3	AWRS1	AWRS2	AWRS3	AWRS4
EMAT	1							
MTS1	.489 **	1						
MTS2	.293 **	.453 **	1					
MTS3	.228 **	.490 **	.484 **	1				
AWRS1	-.267 **	-.223 **	-.353 **	-.284 **	1			
AWRS2	-.278 **	-.125	-.260 **	-.223 **	.648 **	1		
AWRS3	-.240 **	-.190 **	-.247 **	-.285 **	.616 **	.761 **	1	
AWRS4	-.348 **	-.218 **	-.224 **	-.252 **	.512 **	.616 **	.725 **	1

** The correlation is significant at the 0.01 level (2-tailed).

VI. IMPLICATIONS

Pedagogically speaking, the findings of this study imply that students should be encouraged by their instructors to use the formal mobile apps of their learning management systems (e.g., Blackboard) to obtain all of the necessary information regarding their courses and limit the negative effects of techno-overload, instructors should focus on training undergraduate students to effectively manage their time when using mobile apps to accomplish their learning tasks. Instructors should also consider increasing the amount of training for their students on the AWRS that are appropriate with respect to the mobile apps setting.

In addition, instructors should direct students to text in a clear, accurate, and brief style when using mobile apps so that their writing skills do not deteriorate when engaging through this means. This study suggests that there are technical implications for mobile apps developers to consider when making improvements to the language checking functionalities used in mobile apps (e.g., adding a grammar check function, academic writing templates, and features such that it is not able to send a message if a certain language error is detected) to encourage user proficiency in their native language and enhance the quality of their writing skills.

In terms of limiting the negative impacts of techno-complexity and techno-envision, instructors should systematically utilize the appropriate mobile apps that are easy for students to use in their learning practices to reduce the techno-complexity of the technological encounters for students. Additionally, the techno-complexity could be minimized by training students to enhance their confidence and competence by utilizing various technological apps in their learning environments. This study also recommends that universities should develop their formal communication platforms so that they are relatively simple with respect to functions and easy to use in order to motivate students to access them for learning purposes. In addition, university should provide mandatory orientation to undergraduate students to train them on the effective use of formal platform apps (e.g., Blackboard) and to enhance their skills in communicating formally for learning purposes.

VII. CONCLUSION AND LIMITATIONS

This research study aims to explore the effects of EMAT on the AWRS of undergraduate students. The P-T fit model was used to formulate a conceptual framework to address this study goal. The findings indicated that EMAT increases the technostress and that has a negative impact on AWRS. The results of this study show the acceptance of all three of the hypotheses proposed in the causal model. The effect of technostress in this study contributed to techno-overload, techno-invasion and techno-complexity. Ultimately, it was found that the effects of EMAT extended to four aspects of AWRS: accuracy, clarity, cohesiveness, and vocabulary.

Certain limitations are to be considered when interpreting these study results. First, this study was conducted with a

TABLE 7. The survey questionnaire.

First Section: Demographical Characteristics					
Gender: 1. Male 2. Female					
Age: 1. Less than 18 years old 2. 18-22 years old 3. 23-26 years old 4. More than 26 years old					
Academic major: ……………………………………..					
The extent of mobile apps texting for learning purposes: 1. Sometimes 2. Average 3. Considerable 4. Excessive					
Second Section: The Instrument					
1 = Strongly Disagree **2 = Disagree** **3 = Undecided** **4 = Agree** **5 = Strongly Agree**					
Writing (texting) through mobile apps (EMAT) I use writing (texting) frequently through mobile apps to perform the following academic tasks and activities:					
Sentence	**1**	**2**	**3**	**4**	**5**
1. I communicate with instructors regarding the course content and assessment methods.					
2. I discuss course content and assessment methods with other students.					
3. I cooperate with other students to complete the course projects.					
4. I do quizzes.					
5. I evaluate the course.					
6. I inquire about general academic topics about (admission and registration systems and regulations - activities - duties - committees).					
Technostress (Techno-overload) (MTS1) When working on tasks related to learning, I find myself forced to write (text) through mobile apps to do the following:					
Sentence	**1**	**2**	**3**	**4**	**5**
7. Type very quickly					
8. work harder than I can when I write.					
9. Type in a very tight time					
10. change my way of writing to adapt to new mobile apps.					
11. have to deal with the high workload due to the increasing complexity of technology.					
Technostress (Techno- invasion) (MTS2) When writing (texting) through mobile apps (for learning tasks):					
Sentence	**1**	**2**	**3**	**4**	**5**
12. I spend less time with my family.					
13. I have to perform my homework during the weekend.					
14. I have to sacrifice my comfort time to keep up with the updates in the mobile apps.					
15. I feel that my personal life has been exposed to a techno-invasion.					
Technostress (Techno-complexity) (MTS3) When writing(texting) to do learning tasks:					
Sentence	**1**	**2**	**3**	**4**	**5**
16. I do not know enough about mobile apps to write to perform learning tasks in a satisfactory manner.					
17. I need a long time to understand how to write (text) through the mobile apps.					
18. I do not find enough time to develop my writing skills through mobile apps.					
19. I find that my colleagues know more about writing (texting) through mobile apps than I know.					
20. I find that it is very complicated to understand how to write (text) through new mobile apps.					
Academic writing skills (Accuracy) (AWRS1) When writing (texting) through mobile apps:					
Sentence	**1**	**2**	**3**	**4**	**5**
21. I carefully consider the grammatical rules when writing (texting) through mobile apps.					
22. I carefully consider the spelling rules when writing (texting) through mobile apps.					
Academic writing skills (Clarity) (AWRS2) When writing (texting) through mobile apps:					
Sentence	**1**	**2**	**3**	**4**	**5**
23. I committed to the idea of the main topic and do not deviate from it when writing (texting) through mobile apps.					
24. I can arrange my thoughts in a logical manner when writing through the mobile apps.					
25. I can clearly articulate my thoughts when writing through mobile apps.					
Academic writing skills (Cohesiveness) (AWRS3) When writing (texting) through mobile apps:					
Sentence	**1**	**2**	**3**	**4**	**5**
26. I can use the appropriate linking tools when writing through mobile apps.					
27. I can arrange my thoughts into sequence points when writing through mobile apps.					
28. I use punctuation tools when writing through mobile apps.					
Academic writing skills (vocabulary)(AWRS4) When writing (texting) through mobile apps:					
Sentence	**1**	**2**	**3**	**4**	**5**
29. I use basic/simple vocabulary when writing (texting) through mobile apps.					
30. I use academic vocabulary when writing (texting) through mobile apps.					
31. I use the appropriate expressions of intentional meaning in a briefly manner when writing (texting) through mobile apps.					
32. I use abbreviations and symbols when writing (texting) through mobile apps.					

limited number of male students and inequivalent numbers of students enrolled in different university colleges. Future research can probably test the robustness of the findings by investigating the effect of students' gender, age, and academic major on the results. Second, the negative influence of excessive mobile texting on academic writing skills is only one of the behavioral strains to consider, and future work could investigate other strains such as reading literacy or creative writing skills. Future research should investigate the impact on students' academic writing skills in the Arabic language of their excessive mobile texting of English words or Saudi dialects. To further examine the robustness of the causal model in this study, future attempts should also consider the generalizability of these results and their implications for a specific context such as academic texting through social mobile apps (e.g., blogs and wikis).

APPENDIX
SURVEY INSTRUMENT

See Table 7.

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