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Acceptance of mobile English learning among college students in Henan

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ABSTRACT

The portability of smartphones offers tremendous potential for language learning. However, the willingness to accept and the practical adoption of mobile learning in English study among college students from Henan, China requires deeper exploration, due to the lower digital competency and limited usage of digital tools of English teachers in Henan, China. Targeted at the college students from Henan, this research intends to investigate factors influencing their intention to adopt mobile apps in learning English by conducting a quantitative study within the framework of modified technology acceptance model (TAM) model. Purposive sampling method was used and online questionnaire was administered among 511 college students with mobile English learning experiences from one comprehensive university in Henan and data were analyzed via SPSS and structural equation modelling (SEM). The key findings include: i) social influences (SI), perceived usefulness (UF), and perceived enjoyment (PEEN) significantly impact students' intention to adopt mobile English learning; ii) SI affect students' intention via the mediator of UF; and iii) perceived ease of use (EOU) does not significantly impact students' intention. This research highlights the role of teachers' influences in students' adoption of mobile English learning and emphasizes the need for further improvement in mobile apps design to facilitate the learning experiences.

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1. INTRODUCTION

The latest data released by Statista 2023 revealed that nearly 6.4 billion people worldwide had smartphone mobile network subscriptions in 2022, and that figure is expected to approach 7.7 billion by 2028. In line with this trend, mobile learning has emerged as a prominent educational tool [1]. Mobile learning has become an indispensable part of education nowadays, especially in higher education setting [2], [3]. Particularly after COVID-19 pandemic, mobile learning has gained popularity in schools at all levels across China [4].

Compared to traditional learning methods, mobile learning is distinguished by its portability and mobility, which guarantees that learning is widely available, accessible, and flexible [5]–[7]. The widespread acceptance of mobile technology has allowed for more novel and flexible approaches to language education.

The integration of mobile technology in language learning, termed as "mobile-assisted language learning" (MALL), is conceptualized as the education mode integrating the application of portable devices like laptops, personal computers (PCs), mobile phones, and personal digital assistants (PDAs) to accelerate language acquisition [8]. MALL offers tremendous potential and benefits [9], because it is free from location and time constraints [10], and thus provides new opportunities for both foreign language learners and teachers [11].

Despite the benefits, the adoption of mobile learning technology in universities in Henan, China, remains limited. This is partly due to the low information and communication technology (ICT) competency of teachers and a lack of sufficient training on the effective use of technology in the classroom [12], [13]. In some institutions, there are still requirements for teachers to prepare hand-written lesson plans [14]. The active and effective integration of information technology by educators plays a significant role in motivating students to engage with digital tools in their studies. On the other hand, the inadequate use of mobile learning tools by teachers may inhibit students from adopting such technologies themselves [12], [15]. Consequently, it raises an important question: how have the inadequate skills of teachers influenced students' perceptions of MALL, particularly their willingness or intention to use (INT) mobile apps in actual English learning? Therefore, exploring students' perceptions of mobile learning in Henan universities holds practical significance.

Existing research in China has rarely integrated 'perceived enjoyment' (PEEN) and 'social influence' into the technology acceptance model (TAM) to examine mobile learning adoption, particularly in the context of MALL [16]. This study addresses this critical gap by not only incorporating these underexplored factors but also situating the research within Henan, where teachers' ICT skills have been identified as insufficient, an issue that could significantly shape students' adoption of mobile learning. Unlike previous studies focusing on technological or individual impact on behavioral intention [17], [18], this research emphasizes the role of social influences (SI), particularly from teachers, in shaping students' intentions to adopt mobile apps for English learning. Moreover, it extends the TAM framework by exploring how PEEN and SI interact with core TAM elements to shape students' attitudes and behavioral intentions. By doing so, this study contributes novel insights into the broader social and institutional dynamics that affect mobile learning adoption, offering valuable implications for the effective integration of mobile technology in educational contexts. As such, the study aims to answer the following questions:

- What are the influencing factors that impact on the intention of college students from Henan to adopt mobile learning in English study? (RQ1)
- How do SI impact on the intention of college students from Henan to adopt mobile learning in English study? (RQ2)

2. THE COMPRHENSIVE THEORETICAL BASIS

Given that mobile learning technology is perceived as an innovative education tool, the study applies TAM as guiding framework. TAM, put forward by Davis [19], applied the theory of rational behavior to people's acceptance and use of information systems. This theory highlighted that factors such as intrinsic beliefs, subjective attitudes, behavioral intentions, and external variables can explain and predict people's acceptance of information systems [17], [18].

The TAM model proposes two key factors that determine whether people accept a new technology: perceived usefulness (UF) referring to the belief which users expect a new technology or product to improve the performance) and perceived ease of use (EOU) referring to the belief that a new technology or product is easy to use [20]. Davis [19] believed that among many factors, usefulness perception and ease of use perception played a major role in predicting users' acceptance and behavioral intentions towards a new technology or product. This model has been validated by numerous scholars to be scientific and effective, and thus been widely explored in the context of technology-mediated education [21], [22].

As technology advances, additional factors have been integrated to the TAM model. "PEEN" was added to the original TAM model, and defined it as the belief that utilizing a new system or technology was thought to be entertaining, despite performance results from the system or technology use [23]. PEEN is an important factor that affects users' acceptance of new technologies [24]. Information technology users' attitudes are positively correlated with their level of comfort. Users that are at ease and content with information technology systems will perform their tasks efficiently. The positive impact of PEEN on individual's INT has been validated in prior studies [25], [26]. Another key factor, SI, first proposed as "subjective norm" in theory of reasoned action, has been incorporated into the TAM model later and also proved to have an impact on the desire to embrace the technology in earlier studies [27], [28].

Given the unique features of mobile learning apps, this study integrated two additional factors: PEEN and SI, in the TAM model to investigate potential influencing factors that could impact college students from Henan in their use of mobile apps for English learning. Therefore, the research developed a

model with five constructs: SI, UF, EOU, PEEN, and INT, to explore factors impacting the utilization of mobile apps in English study. The proposed research model was depicted in Figure 1, illustrating the relationship between the five constructs: SI, UF, EOU, PEEN, and INT. The proposed hypotheses were as:

- H1: UF positively affects the intention of college students from Henan in using mobile apps to learn English.
- H2: EOU positively affects the intention of college students from Henan in using mobile apps to learn English.
- H3: PEEN positively affects the intention of college students from Henan in using mobile apps to learn English.
- H4: SI positively affect college students' UF of mobile apps in the English study.
- H5: SI positively affect the intention of college students from Henan in using mobile apps to learn English.
- H6: SI positively affect the intention of college students from Henan in using mobile apps to learn English through the mediator of UF.

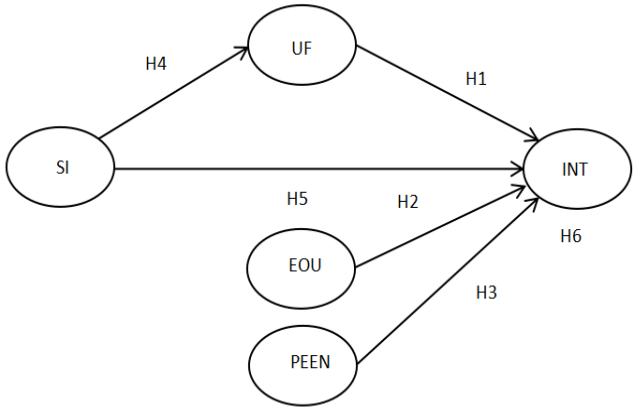

Figure 1. Proposed research model

3. METHOD

This study employed quantitative research design to explore the causal relationships between the constructs as described in Figure 1. Quantitative research methods is effective in identifying causal relationships through systematic and objective approaches. Moreover, this structured approach enables researchers to generalize findings to larger population [29], [30]. Therefore, this quantitative approach was essential for achieving the research objectives.

3.1. Instrument

This quantitative study employed a questionnaire-based survey to collect the required data. Based on previous TAM-related studies [31]–[34], the questionnaire was developed with measurement items adapted for each construct. The questionnaire measured five constructs, namely SI, UF, EOU, PEEN, and INT, with five items under each construct. To ensure the content validity of the questionnaire, the questionnaire was revised based on the feedback provided by two experts in the field of educational technology.

There were two sections in the questionnaire, in which the first section covered the respondents' basic demographic information involving gender, educational level, family background, major, English performance level, and previous experience in using mobile learning. The second section mainly explored influencing factors of using mobile apps to learn English. Responses were measured on a seven-point Likert scale, with "1" representing strongest disagreement and "7" representing strongest agreement. Reliability and validity of the scale were tested by SPSS 29.0. The results of the reliability and validity of the scale were displayed in Tables 1 and 2. The Cronbach's alpha value for all the measurement constructs were above 0.90, and Kaiser-Meyer-Olkin (KMO) stood at 0.977, which indicated that the questionnaire had good reliability and validity [35].

3.2. Sampling

Purposive sampling was employed to select college students from Henan with experience in using mobile language learning apps. Based on the proposition of Kline [36], the sample size should be 10 times

the number of measuring items in the research model. Since there were 25 items, at least N=250 sample were required. The questionnaire was administered through the online platform 'Wenjuanxing' among 542 college students from one comprehensive university in Henan, Central China. About 511 valid responses were retrieved after deleting 31 invalid questionnaires due to unengaged response with no standard deviation of the answers. The basic information of the surveyed college students included gender, education level, family background, speciality, and English level. As shown in Table 3, female students (325) outnumbered male students (186), accounting for 63.6% of the total. In terms of English level, 32.09% of students scored 80-100 out of 150 full mark English test in Chinese college entrance examination, 31.31% of students scored 60-80, and 25.25% of students scored below 60. It can be readily seen that students' English proficiency were generally low.

Table 1. Reliability of the measurement items

Construct	Variables	Cronbach's alpha if deleted	Cronbach's alpha
SI	SI1	0.884	0.908
	SI2	0.892	
	SI3	0.878	
	SI4	0.889	
	SI5	0.898	
UF	UF1	0.935	0.950
	UF2	0.933	
	UF3	0.940	
	UF4	0.943	
	UF5	0.939	
EOU	EOU1	0.917	0.937
	EOU2	0.923	
	EOU3	0.917	
	EOU4	0.932	
	EOU5	0.921	
PEEN	PEEN1	0.931	0.941
	PEEN2	0.926	
	PEEN3	0.930	
	PEEN4	0.924	
	PEEN5	0.925	
INT	INT1	0.926	0.941
	INT2	0.925	
	INT3	0.925	
	INT4	0.931	
	INT5	0.928	

Table 2. Validity of the measurement items

KMO measure of sampling adequacy		0.977
Bartlett's test of sphericity	Approx. Chi-square	14379.913
	df	300
	Sig.	<0.01

Table 3. Frequency table of the basic information

Variable	Items	Frequency	Percent (%)
Gender	Male	186	36.40
	Female	325	63.60
	Total	511	100.0
Education level	Undergraduate (art major)	81	15.85
	Undergraduate (non-art major)	189	36.99
	Total	511	100.0
Family background	City	210	41.10
	Village	301	58.90
	Total	511	100.0
Specialty	Science and engineering	277	54.21
	Liberal arts	234	45.79
	Total	511	100.0
English score of Chinese college exam	Over 100	58	11.35
	80-99	164	32.09
	60-79	160	31.31
	40-59	87	17.03
	Below 40	42	8.22
	Total	511	100.0

3.3. Data analysis

Data was analyzed using SPSS and structural equation modelling (SEM). The following steps were taken. Firstly, the mean, variance and other statistical indicators of each variable would be analyzed as descriptive statistics. Secondly, the convergent validity and the discriminant validity of each construct would be analyzed in the measurement model. Thirdly, the impact of independent variables (SI, EOU, UF, and PEEN) on the dependent variable (INT) would be evaluated in the structural model. Fourthly, the impact of the independent variable (SI) on the dependent variable (INT) through the mediating role of UF would also be explored. Finally, each proposed hypothesis exploring the causal relationship among the constructs would be tested.

4. RESULTS AND DISCUSSION

4.1. Descriptive statistical analysis

The valid questionnaire (511) had mean values ranging between 4.67 and 5.14. Standard deviation ranged between 1.21 and 1.28 with Skewness value ranging between -0.707 and -0.243, and Kurtosis value between -2.07 and 0.49. The specifics of descriptive analysis were listed in Table 4.

Table 4. Descriptive analyses of the items

Variables	max	min	Mean	SD	Skewness	Kurtosis
SI1	7	1	4.77	1.24	-0.301	0.097
SI2	7	1	4.69	1.25	-0.293	0.101
SI3	7	1	5.07	1.24	-0.579	0.362
SI4	7	1	5.14	1.21	-0.707	0.532
SI5	7	1	4.78	1.28	-0.239	-0.207
UF1	7	1	4.75	1.24	-0.291	0.010
UF2	7	1	4.78	1.22	-0.270	-0.093
UF3	7	1	4.84	1.26	-0.314	-0.172
UF4	7	1	4.79	1.21	-0.255	-0.041
UF5	7	1	4.99	1.24	-0.511	0.333
EOU1	7	1	4.95	1.21	-0.321	-0.154
EOU2	7	1	4.91	1.19	-0.269	-0.121
EOU3	7	1	4.95	1.17	-0.393	0.109
EOU4	7	1	4.94	1.23	-0.328	0.038
EOU5	7	1	5.00	1.20	-0.380	0.054
PEEN1	7	1	4.86	1.18	-0.243	-0.108
PEEN2	7	1	4.67	1.22	-0.441	0.212
PEEN3	7	1	5.00	1.22	-0.455	0.219
PEEN4	7	1	4.85	1.22	-0.327	0.124
PEEN5	7	1	4.90	1.19	-0.313	0.309
INT1	7	1	4.81	1.22	-0.263	0.021
INT2	7	1	4.91	1.18	-0.369	0.268
INT3	7	1	4.93	1.19	-0.474	0.306
INT4	7	1	4.78	1.21	-0.289	0.067
INT5	7	1	5.04	1.26	-0.571	0.549

4.2. Reliability and validity of measurement model

The measurement model was assessed by AMOS 26.0 in terms of reliability and validity. In this study, the measurement model was assessed by the maximum likelihood estimation approach. The parameters calculated included factor loading, composite reliability (CR), and average variance extraction, and the results were shown in Table 5. The factor loading after standardization ranged from 0.788 to 0.926, all greater than 0.6, indicating that every item in the questionnaire was reliable. Furthermore, the CR value of every construct exceeded 0.8, meeting expert-recommended standards, therefore reflecting strong internal consistency across all constructs. Additionally, the average variance extraction value of the five constructs all exceeded 0.5, suggesting solid convergent validity. After that, the discriminant validity was assessed through the average variance extracted (AVE) method. Discriminant validity can be assessed by comparing the square roots of AVE values for every construct with the Pearson correlation coefficient among different constructs. If the square roots of AVE exceed the corresponding Pearson correlation coefficient, the good discriminant validity is achieved [37]. The results indicating in Table 6 exhibited that the Pearson correlation coefficients between all variables were lower than the square root of the AVE values, thus reflecting strong discriminant validity.

Table 5. Convergent validity of the measurement model

Independent variable	Dependent variable	Factor loading	CR	AVE
SI	SI01	0.837	0.916	0.687
	SI02	0.799		
	SI03	0.882		
	SI04	0.834		
	SI05	0.788		
UF	UF01	0.902	0.952	0.798
	UF02	0.926		
	UF03	0.884		
	UF04	0.861		
	UF05	0.893		
EOU	EOU01	0.899	0.941	0.761
	EOU02	0.889		
	EOU03	0.906		
	EOU04	0.816		
	EOU05	0.848		
PEEN	PEEN01	0.856	0.945	0.774
	PEEN02	0.885		
	PEEN03	0.862		
	PEEN04	0.899		
	PEEN05	0.895		
INT	INT01	0.894	0.945	0.774
	INT02	0.873		
	INT03	0.894		
	INT04	0.859		
	INT05	0.877		

Table 6. Discriminant validity of the measurement model

Variable	AVE	SI	UF	EOU	PEEN	INT
SI	0.687	0.829				
UF	0.798	0.758	0.893			
EOU	0.761	0.724	0.549	0.872		
PEEN	0.774	0.707	0.536	0.722	0.88	
INT	0.774	0.750	0.699	0.673	0.746	0.88

4.3. Structural equation modelling

4.3.1. Model fit

The structural model results were analyzed using the most widely used fit indicators obtained from the standard by Hair Jr. *et al.* [38]. Results in Table 7 indicated that (χ^2/DF)=3.823, root mean square error of approximation (RMSEA)=0.074 (below 0.08), standardized root mean square residual (SRMR)=0.08, Tucker-Lewis index (TLI), also known as non-normed fit index (NNFI)=0.937, comparative fit index (CFI)=0.944, goodness-of-fit index (GFI)=0.926, and adjusted goodness-of-fit index (AGFI)=0.917. With CFI, GFI, and AGFI exceeding 0.9, it indicated that the model fit was acceptable.

Table 7. Model fit of the research model

Indicators	Standard	Model fit of research model
MLχ^2	The small the better	1020.818
Degrees of freedom (DF)	The large the better	267.000
χ^2/DF	1<χ^2/DF<3	3.823
RMSEA	<0.08	0.074
SRMR	<0.08	0.080
TLI (NNFI)	>0.9	0.937
CFI	>0.9	0.944
GFI	>0.9	0.926
AGFI	>0.9	0.917

4.3.2. Analysis of structural model

Table 8 exhibited the results of path coefficients, reflecting that SI significantly affected UF with b=0.758 and p<0.001. At the same time, SI (b=0.171, p=0.001), UF (b=0.306, p<0.001), and PEEN (b=0.387, p<0.001) all significantly influenced the INT. However, EOU (b=0.102, p=0.052) did not significantly influence the INT. Furthermore, explained variance R^2 for UF and INT were 0.575 and 0.699, respectively as shown in Figure 2, indicating that 57.5% of UF's variance was explained by SI and 69.9% of INT's variance was explained by the four key constructs, SI, UF, EOU, and PEEN.

Table 8. Path coefficients of the structural model

Hypothesis	Std.	Unstd/S.E.	p value	Supported or not
H1(UF-INT)	0.306	5.538	0.000	Supported
H2(EOU-INT)	0.102	1.945	0.052	Not supported
H3(PEEN-INT)	0.387	7.790	0.000	Supported
H4(SI-UF)	0.758	17.666	0.000	Supported
H5(SI-INT)	0.171	3.251	0.001	Supported

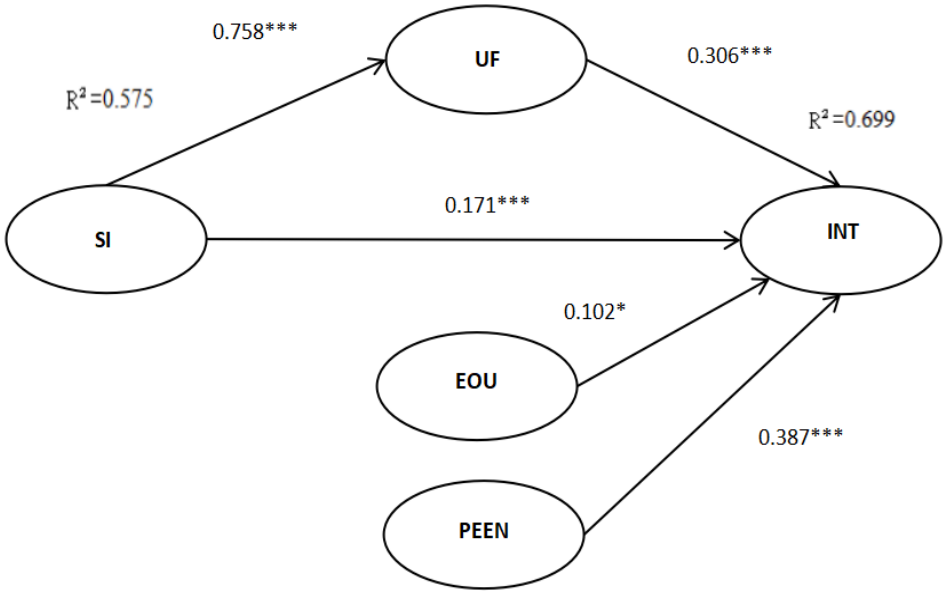

Figure 2. Results of SEM

4.3.3. Testing of the hypotheses

The results of the path coefficients were displayed in Table 8, providing a detailed overview of the relationships between the variables in the study. This table illustrated the strength and direction of each path coefficient, offering valuable insights into the underlying connections among the constructs. By examining these results, the significance of each pathway and the overall structural validity of the proposed model could be assessed.

- H1: this hypothesis is supported with path coefficient of 0.306 and $p<0.001$, indicating that UF significantly affects students' willingness to use mobile apps in English study.
- H2: this hypothesis cannot be supported with path coefficient of 0.102 and $p=0.052$, indicating that EOU does not significantly affect students' willingness to use mobile apps in English study.
- H3: this hypothesis is supported with path coefficient of 0.387 and $p<0.001$, indicating that PEEN significantly affects students' willingness to use mobile apps in English study.
- H4: this hypothesis is supported with path coefficient of 0.758 and $p<0.001$, indicating that SI significantly affect students' UF of mobile apps in English study.
- H5: this hypothesis is supported with path coefficient of 0.171 and $p<0.001$, indicating that SI significantly affect students' INT mobile apps in English study.

4.3.4. Analysis of the mediating effect

As shown in Table 9, with bootstrap analysis, the indirect effect of SI on INT through the mediator of UF had a significant p value of 0.045 ($p<0.05$), with the confidence interval [0.028 to 0.502] excluding zero, thus confirming the validity of the indirect effect. However, the direct effect of SI on INT was not significant with $p=0.288$ ($p>0.05$), and at the same time the confidence interval included zero [-0.111 to 0.557], which indicated that UF fully mediated the relationship between SI and INT. Therefore, hypothesis 6 was supported: SI positively affect the intention of college students from Henan in using mobile apps to learn English through the mediator of UF.

Table 9. Mediating effect analysis with bootstrap

Effect	Point estimate	Product of coefficients			Bootstrap 1,000 times Bias-corrected 95%	
		S.E.	Z-value	*p* value	Lower bound	Upper bound
Total effect SI→INT	0.418	0.147	2.852	0.004	0.149	0.719
Total indirect effect SI→INT	0.241	0.120	2.009	0.045	0.028	0.502
Direct effect SI→INT	0.177	0.167	1.063	0.288	-0.111	0.557

4.4. Discussion

This study employed SEM to explore factors influencing the intention of college students from Henan to use mobile learning apps for English study, by incorporating SI and PEEN into the TAM. SI, UF, and PEEN were identified to be significantly related to the INT mobile English learning among these students. Moreover, the findings reflected that the TAM model employed in the study was suitable with high reliability, convergent validity and discriminant validity.

The study aimed to explore the influencing factors of mobile English learning among college students from Henan, through analyzing the relationship between SI, UF, EOU, PEEN, and the INT. The finding indicated that UF significantly enhanced students' INT mobile learning apps to study English, which was consistent with prior studies [39], [40]. Therefore, it can be confirmed that college students who hold the mobile apps as beneficial in their English study will be more willing to use mobile apps for English learning. It was worth to note that EOU had no significant positive impact on the intention of college students from Henan to use mobile apps to learn English. This result was not consistent with the previous results [41]–[45]. It was found out that among all the items in the construct of EOU, the item "I can easily obtain materials from mobile learning apps" averaged the least of 4.75. It indicated that the learning resources provided on many mobile learning apps were not easily available, resulting in poor usability.

The finding also indicated that PEEN, however, had a significant positive effect on the INT mobile learning apps. This result was consistent with previous findings, which also highlighted the importance of enjoyment in influencing technology acceptance and usage [46]–[48]. Therefore, it can be inferred that for college students from Henan, if using mobile apps to learn English is interesting and enjoyable, it is more likely that they will use it in their future study. Thus, fostering a sense of enjoyment in mobile learning process may play a crucial role in the adoption of mobile learning.

The study also aimed to explore how SI impacted on the INT by examining the relationship between SI, UF, and the INT. The findings confirmed the positive relationship between the SI and INT through the mediating role of UF. The impact of SI on UF aligned with previous research [49], [50]. The measurement item "if teachers recommend mobile learning apps to me for learning English, I would be willing to use it" averaged the highest in SI construct. It indicated that suggestions and guidance from teachers would play a crucial rule in influencing college students' adoption of mobile apps in their English learning.

5. CONCLUSION

This study explored the college students' intention to adopt mobile learning in English study from Henan Province in Central China. Three factors were confirmed to have significant impacts on the INT mobile learning apps among the students: SI, UF as well as PEEN. A further analysis of SI revealed that teachers' positive attitudes towards the use of mobile learning and the actual active integration of mobile technology in teaching would have a great impact on students' attitude of the adoption of mobile learning in English study. To conclude, the study's findings will enable school administrators to look into existing problems of incompetency of teachers in the integration of information communication technology in daily teaching and the provide practical insights for practitioners in their efforts to consider modifications in designing mobile learning apps. The study proposes that the mobile learning apps need to provide and keep updating and enriching learning resources to make the English learning much more efficient and enjoyable. More importantly, the interface of the mobile learning apps needs to be more user-friendly since students hold negative views toward the ease of use of current mobile learning apps. Furthermore, it is advisable to have school authorities and teachers to promote and integrate more of the mobile learning mode in teaching and learning, since SI especially the influences on the part of teachers play a crucial role in shaping Chinese students' perception and adoption of mobile learning technologies. The role of ease of use required further investigation in future research, particularly in light of the inconsistency compared to findings from earlier studies. These discrepancies suggest the need for deeper exploration of the factors contributing to such variations. The study was conducted within the Henan Province of China, which made the generalizability of the findings limited. Moreover, the study was quantitative in nature to explore the relationships between the measuring constructs, and the result would be complemented with further qualitative analysis.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
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Soo Ruey Shing	✓	✓		✓						✓		✓		
Yu Lv			✓	✓		✓	✓			✓				

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author [SRS], upon reasonable request.

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