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Technical and Individual Factors Influencing Mobile Learning in China's Higher Education during the Outbreak of Covid-19

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Abstract: The COVID-19 pandemic has swept the world like a tornado, caught unprepared of the Chinese higher education system to adapt to widespread unexpected disruption. It forced university students transfer to mobile learning during epidemic disease period, but students' learning efficiency had become a concern for teachers who were used to face-to-face pedagogy. This study applied mixed methods. Qualitative phase interviewed 12 freshmen with e-mail, then constructed a model by thematic analysis that ultimately affects mobile learning efficiency. Quantitative phase survived 367 freshmen by questionnaire and test previous model. The result of path analysis in quantitative phase indicated that individual factors and technological factors positively affect mobile learning acceptance, mobile learning acceptance positively affect mobile learning efficiency. The contributions of this study have strong implications for universities whom conducting mobile learning in other regions, that were still in the midst of the epidemic.

Keywords: *Covid-19; mobile learning; China; mix-method; path analysis.*

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1. Introduction

On Jan 30, 2020, World Health Organization (WHO) declared the current COVID-19 epidemic a Public Health Emergency of International Concern (WHO, 2020). People might not be able to return to normal in a short period (Lancet, 2020), there is still talk of recovery and what form it should take whilst the virus continued to beat a concerning and complex path. The COVID-19 pandemic exposed the inability of the Chinese higher education system to adapt to widespread unexpected disruption. This has forced a great number of organizations to undertake emergent transformation, as such, reconsidering main elements of pedagogy in Chinese higher education. China took the lead to announce lockdown of majority provinces at the beginning of the range, followed by strict restriction of leaving and arriving in different provinces. According to the documents from the Chinese Educational Ministry and Education Department on March 4th, 2020 (Education, 2020), all schools including university, high school, elementary school and kindergarten were not allowed to face-to-face lecturing until the COVID-19 outbreak was basically under control. The research problems and objectives were extracted from a series of discussions with three professors in a Chinese university located at the north west. There was no empirical research on the corresponding response to full-scale mobile learning. Hence, the way to make students accept mobile learning more efficiently in distance learning class became a worthy topic of study.

There were enough evidences (Reynolds & Anderson, 2015; Shadiev et al., 2017; Wu, 2014; Zhonggen et al., 2019) to state that mobile learning could be accepted among higher education during the peace without any disaster like COVID-19. Hence, the research tests the acceptance of technology adoption during disaster like COVID-19. Furthermore, there had never been large-scale intensive use of this mobile learning. The way to enable students to accept this pedagogy actively and efficiently, which had become a valuable avenue for examination.

Guided by the above, this study aims to investigate two specific research questions obtained as follows: How well was mobile learning accepted during the Covid-19 outbreak in China? What factors influence the implementation of mobile learning for freshmen during Covid-19 pandemic in China?

2. Method

Tashakkori and Creswell (2008) recognized the popularity of mixed methods research to the influence of two parallel factors: the need to apply possible methodologies to provide answers for complex study research questions, and the need of social phenomena that to indicate the exploration

of cultural conflicts from various aspects. Due to the lack of essential early data support before Covid-19, sequential interpretation methods were appropriate where the qualitative approach initially adopted, followed by the quantitative method (Creswell, 2017). Moreover, the main reason was that a Qual → Quan sequential method inform the development of a new measurement instrument when a needed tool is not available (Halcomb & Hickman, 2015). In order to increase the understanding of potential phenomena, emphasis was put on qualitative analysis (Onwuegbuzie & Combs, 2011). Therefore, quantitative findings were built upon the results of the qualitative approach. A quantitative phase of the study extracted sampling from the preceding qualitative group that investigated the survey findings to reveal more significant levels of understanding. After interview data analysis, this study surveyed students to interpret and expand on qualitative results. The Figure 1.1 adopted from Ivankova (2014) showed the overall process of the data triangulation, as well as made the composition in the last step.

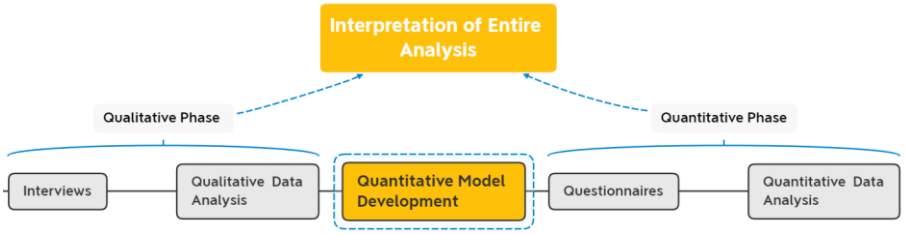

Fig. 1. A Qual → Quan Sequential Design
Source: adopted from Ivankova (2014)

In Social Constructivism, learners are actively involved in constructing understanding in an interactive environment (Kalina & Powell, 2009), which is especially reinforced by students' learning under the COVID-19 pandemic. Additionally, the constructs of this theory support mobile pedagogy with essential components (Abdulrahman et al., 2017; Cochrane & Narayan, 2016; Cohen & Ezra, 2018; Krause et al., 2006). This research accordingly started with the qualitative phase. In terms of qualitative data collection, the saturation theory (Glaser Barney & Strauss Anselm, 1967) recommends that the number of participants is decided by the extent whether the information has reached saturation point, under which data collection will become redundant and repeated. The number of participants in the research is drawn at 12 (twelve) voluntary freshmen when the

responded information is similar and repeated with e-mail. Qualitative data analysis conducted a purposive sampling with thematic analysis. NVIVO 12 was used to perform content analysis instead of manual thematic analysis. Codes, patterns, and themes were discovered from semantic pieces or direct quotes through an inductive prospective to research topics. The term informed consent implies that subject know and understand the risks and benefits of participation in the research (Flynn & Goldsmith, 2013) had been taken into account. Twelve voluntary participants provided sufficient information and procedures during the interviews.

In quantitative component, simple random sampling technique was applied to obtain an inference about the population. To estimate the minimum sample size for this study, Krejcie and Morgan (1970)'s formula was used, which fit the overall framework of this study and data structure. The official enrolment number showed that there were N=4638 freshmen enrolled in 2019/2020 semester. Based on the confidence of 95%, while the typical degree of accuracy of error is 0.05. Putting all these together, Krejcie and Morgan (1970)'s formula shows the sample size required is n=367. SPSS AMOS 26.0 was used to calculate path analysis which reflected the whole correlation between quantitative data. Meanwhile, the quantitative results tested the framework developed by qualitative phase.

3. Qualitative Data Analysis and Results

Based on constructivism in education from Steffe and Gale (1995), teachers were the promoters of class construction, but not the one of perfusion. Students were active constructors, rather than the passive receivers or indoctrinated objects of external stimuli. This analytical process provided a qualitative portrait of the respondents' concerns, attitudes, ideas, mind-sets, and feelings. Based on this, common phrasing and expressions, context and patterns of speech were analyzed to invest the significant points.

The written records of interviews were analyzed using thematic analysis. The detailed descriptions of email interview participants were captured and then encapsulated into thematic tree (Fig.2). These seven themes were then presented under the four constructs: technical factors, individual factors, mobile learning acceptance and mobile learning efficiency. Theories were formulated to explain, predict, and understand phenomena (Labaree, 2013). More elaborately, Theme 1 and Theme 2 role lied in connecting from technical factors. The laptop was the most popular mobile devices among students with the reasonable ground. Nobody wanted to

cancel an entire semester because of COVID-19 because of any technical issue. Fortunately, technical convenience existed in mobile learning, which had made previous technical issue no longer a problem. Theme 2 explored current deficiencies of implementing mobile teaching. It was a problem for the sense of reality lost in mobile learning, but whatever the application of technology, the person who uses it was the actual key.

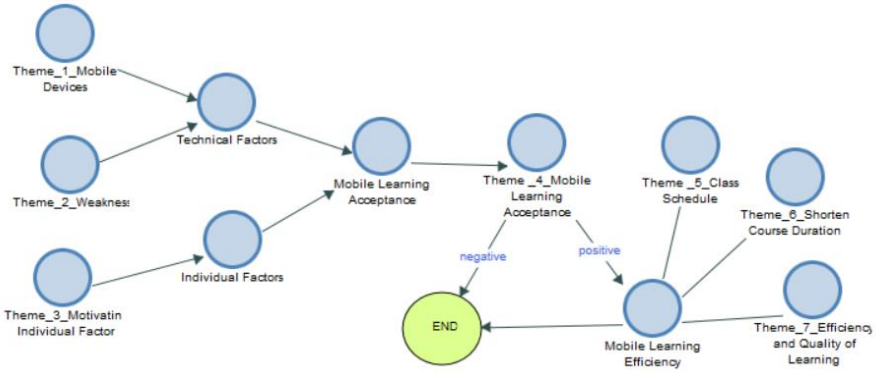

Fig. 2. The Thematic Tree (Source: Authors own contribution)

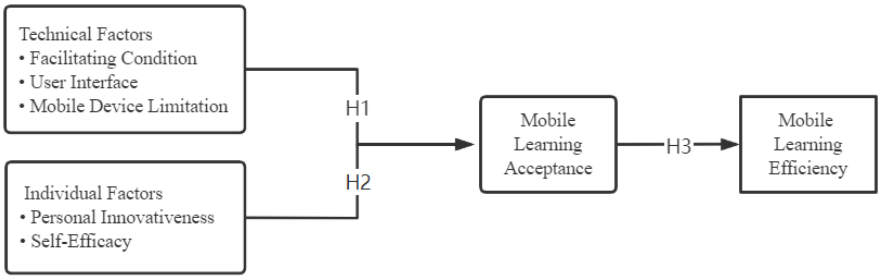

Fig. 3. Research Framework (Source: Authors own contribution)

Given that mobile learning had been implemented on a large-scale without any previous experience, Theme 3 once again verified "convenience" was the most important factor to make students accept it. Theme 4 played the role of the intermediary switch to determine whether continue the interview or not. Whereas, the findings had proven that mobile learning was an acceptance technology during COVID-19. Also, twelve participants totally expressed positive answer. Furthermore, twelve participants were towered to response last question. Theme 5 and Theme 6 from interview responses indicated that the preference of students in mobile

learning had a high level of interactivity with class schedule and the length of the class.

Finally, highlighted findings of the research appeared from Theme 7, mobile learning decreased the efficiency and quality of mobile learning. Although, one interviewee took the opposite view, her opinions set several prerequisites like self-learning, self-discipline and objective oriented learning. Another one interviewee responded that as a freshman he already had the consciousness of independent learning, but his self-awareness and learning efficiency without supervision were not assuring. The other four interviewees reported their efficiency and quality decreased. Using mobile learning instead of conventional class for a long time caused consciousness and concentration overloaded. Hence, the research framework based on a realistic case, a new hybrid model as Fig. 3, whilst the results would be further tested using quantitative analysis.

4. Qualitative Data Analysis and Results

According to Briz-Ponce et al. (2017), the criteria of Cronbach's alpha, KMO, Bartlett's Test and Factor loading was mainly reliability measurements. The following criteria had been used: i. Regarding reliability, value of Cronbach's alpha should be larger than 0.7 (Sharma, 2016); ii. Value of KMO should be larger than 0.7 (Fury & Harrison, 2011; García-Santillán et al., 2013); iii. Bartlett's test of Sphericity is smaller than 0.05 (Fury & Harrison, 2011; García-Santillán et al., 2013); iv. Regarding validity, Fornell and Larcker (1981) and Briz-Ponce et al. (2017) suggest that if the value of factor loading was above 0.5.

Table 1. Description of the Reliability and Validity
(Source: Authors own contribution)

Indicator	Cronbach's Alpha	KMO	Bartlett's Test	Factor Loading
FC1	0.883	0.500	0.00	0.903
FC2				0.900
UI1	0.941	0.772	0.00	0.922
UI2				0.917
UI3				0.923
ML1	0.943	0.862	0.00	0.884
ML2				0.905
ML3				0.898
ML4				0.916
PI1	0.895	0.500	0.00	0.897

PI2				0.902
SE1	0.949	0.870	0.00	0.918
SE2				0.909
SE3				0.904
SE4				0.916
MLA1	0.960	0.917	0.00	0.922
MLA2				0.905
MLA3				0.923
MLA4				0.916
MLA5				0.904
MLE1	0.959	0.920	0.00	0.923
MLE2				0.908
MLE3				0.909
MLE4				0.896
MLE5				0.914

Note: FC=Facilitating Condition; UI=User Interface; ML=Mobile Device Limitation; PI=Personal Innovativeness; SE=Self-Efficacy; MLA=Mobile Learning Acceptance; MLE=Mobile Learning Efficiency.

All the parameters included in Table 1 are in accordance with the criteria. As a result, reliability was acceptable. Thus, based on the results drawn from the composite reliability, it can be assumed that this research has an internal proper consistency reliability. Pertaining to relevant values presented in Table 2, all AVE values are higher than 0.5, it is therefore concluded that the convergent validity is evident. Furthermore, square root of AVE that bold at correlation coefficients and diagonal presented in Table 2.

Table 2. Average Variance Extracted (AVE)

Construct	AVE-Value
TF	0.823
IF	0.824
MLA	0.835
MLE	0.828

(Source: Authors own contribution)

Table 3. showed that, the square root of AVE for each construct, is greater than its correlation coefficient with the other constructs. It means that the result of survey presents good discriminant validity, whilst both convergent and discriminant validity of the measures in this study were

established. In summary, the results suggest the validity and internal consistency reliability of this research.

Table 3. Correlation Matrix and Discriminant Validity

Construct	TF	IF	MLA	MLE
TF	**0.907**			
IF	0.283	**0.908**		
MLA	0.302	0.302	**0.908**	
MLE	0.253	0.280	0.304	**0.910**

Note: Diagonal bolding is square root of AVE.
(Source: Authors own contribution)

As shown in research framework, technical factors integrated from FC, UI and ML, individual factors integrated from PI and SE. The statistical package of structural equation model-SPSS AMOS 26.0 was applied to test hypotheses with path analysis. Recursive path analysis was used in this study to test hypotheses. It is possible to say the overall goodness of fit of the hypothesized model. The typic fit indices for this model were: CFI=0.673, NFI=0.636 indicating an acceptable fit. The results of significance testing and estimates of the path coefficients were displayed in Table 4.

Table 4. Hypotheses Testing Results with Parameter Estimates

	Path	T-Value	P-Value	Path Coefficient(β)	Decision
H1	TF → MLA	26.304	0.000*	0.423	**Supported**
H2	IF → MLA	53.135	0.000*	0.855	**Supported**
H3	MLA → MLE	47.765	0.000*	0.931	**Supported**

Note 1: TF=Technical Factors; IF=Individual Factors; MLA=Mobile Learning Acceptance; MLE=Mobile Learning Efficiency
Note 2: * P-Value < .001.
(Source: Authors own contribution)

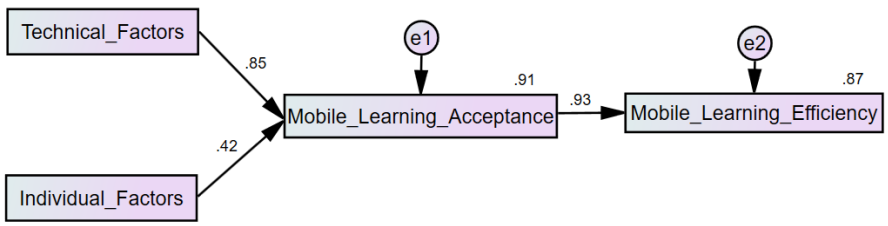

Fig. 4. Path Analysis (Standardized Path Coefficients) of the Mobile Learning Research Model (Source: Authors own contribution)

Three hypotheses out of three were totally confirmed. Three hypotheses were formulated to understand whether technical factors and individual factors can influence freshmen to accept mobile learning efficiently. Schreiber et al. (2006) indicated when the P-Value is less than 0.05, the model sufficiently shows fit indices in relevant path analysis. In this regard, P-Value (see Table 4.) were tested less than 0.01, so that H1, H2 and H3 were confirmed: i: Technical Factors positively impacts on Mobile learning acceptance. ii: Individual Factors positively impacts on Mobile learning acceptance. iii: Mobile learning acceptance positively impacts on Mobile learning Efficiency. Path analysis (with standardized path coefficients) of the proposed research model figure was drew. Significant paths (see Fig. 4) for the model are displayed with bold lines with the path coefficient (β) noted. In relation to this, this study adopted Salkind (2003) critical that if the path coefficient between (β = 0.20, and β = 0.40, moderate when between β = 0.40 and β = 0.60, strong when between β = 0.60 and β = 0.80, and very strong when between β = 0.80 and β = 1.00. Of the three path coefficients (corresponding to the three hypotheses), three were found to be significant statistically. Both technical factors (β = 0.85) and individual factors (β = 0.42) influence mobile learning acceptance. Mobile learning acceptance (β = 0.93) also directly influence mobile learning efficiency.

5. Discussion and Conclusion

This study is an exploratory research that employed a mixed-methods approach. The scheme aimed to pursue the discovery of contradiction and paradox, novel perspectives of frameworks (Bryman, 2006) in which combining quantitative and qualitative research. In this sense, the main objective of the quantitative study was to test the effect and relationship of technical factors, individual factors, mobile learning acceptance and mobile learning efficiency. The results of path analysis once again confirmed the two main factors (technical factors and individual factors) in Chavoshi and Hamidi (2019), model that strictly influence the mobile learning acceptance level. Specifically, technical factors were greater than individual factors where technical factors were highly correlated with mobile learning acceptance, further affected mobile learning efficiency.

Apparently, mobile learning was hard to possess overwhelming advantage to as a substitute of conventional learning, albeit students' readiness for integrating mobile learning during the pandemic. Most students hardly preferred to use mobile learning in the morning. Perhaps, mixing up the afternoon and evening class could be a middle ground to increase students' willingness to attend classes. It was also following sleep habits during the outbreak of COVID-19. What's more, the response of students

seemed as an excuse that students were unwilling to take longer classes. Notwithstanding, the issue may encompass the nature of mobile learning itself.

Noteworthily, when regarding mobile learning efficiency, abstract and professional concepts cannot be explained clearly by the teachers because the whole inanimate learning process was poor feedback effect between students and teachers. Poor feedback as well came from the way to measure students' grades timely. On the one hand, students slacked off lack of corresponding evaluation. On the other hand, teachers lowered their standards for giving priority to students' technical factors, or consoled themselves with pandemic forgiveness. However, to a large extent, the use of mobile learning on a large scale for a long time was a new challenge for freshmen. Whilst the most critical factor was whether they had the confidence to use mobile learning.

Universities in China were consequently forced to call off courses and shut down the campus due to the emergent coronavirus epidemic. Complying with the government's safety instructions, students were required to follow quarantine regulations for their safety during this pandemic. Thus, they reluctantly and unexpectedly switched to this new digital learning method instead of in-class learning. As the epidemic evolves, and the limited metrics available to assess this topic, this study attempts to integrate the appropriate mobile learning pedagogy, in place to proceed integration, seamless transition, and smooth implementation of online learning. Using mobile learning among university has never been serious in formal learning apart before. The contributions of this study have strong implications for universities conducting mobile learning in other regions, that were still in the midst of the epidemic.

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