Investigating the adoption of MOOCs : a technology-user-environment perspective

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Investigating the Adoption of MOOCs: A Technology-User-Environment Perspective

Abstract

MOOCs (Massive Open Online Courses) promise to bridge the digital divide and promote educational equity globally. In spite of its potentials, the adoption rate of MOOCs is still relatively low while the dropout rate is high, especially in developing countries. Yet, research on the adoption of MOOCs in developing countries is still limited. To fill this research gap, this research aims to study the adoption of MOOCs by extending current research on innovation and technology adoption. Here, a conceptual framework, Technology-User-Environment (TUE) was proposed to identify influential drivers and barriers from the technological characteristics of MOOCs as well as the user and the social environmental factors. Eight hundred and twenty-seven individuals in a developing country were invited to participate in a questionnaire survey. Data was analyzed by hierarchical regression and the results show that for the (1) technological characteristics, perceived usefulness was most significant influence, followed by lack of accessibility and performance-to-cost value; (2) user factors, self-regulation was the most significant predictor of MOOC adoption, and female learners showed higher willingness to adopt MOOCs; (3) social environmental factors, tradition and social norms, and lack of information about MOOCs were negatively associated with adoption of MOOCs. Implications and suggestions are discussed at the end of this paper.

Key words: MOOCs, drivers and barriers of adoption, innovation adoption

Introduction

MOOCs (Massive Open Online Courses), as an educational innovation, have gained great attention from educators, learners, and administrators in recent years. Through MOOC platforms, educators are able to upload their teaching videos and course materials, while learners can access these online courses freely or based on a fair charge. Successful examples include edX, Coursera, Udacity, and Open2Study, in which there are numerous courses uploaded by the worlds' leading universities (e.g., Harvard, MIT, Stanford, etc.).

There are several reasons that contribute to the popularity of MOOCs. Firstly, with the prevalence of the Internet, MOOCs have the potential to reach a massive scale of global learners from different countries (Barclay & Logan, 2013). This means that any learners from any part of the world with internet access can take courses from the world's leading universities. Secondly, since learning in MOOCs is often free, it is cost efficient for learners, especially those in developing countries where access to educational resources can be limited (Kennedy, 2014). Thirdly, MOOCs provide learners with a variety of choices to cater to learners' interests and strengths (Means et al., 2009) and thus meeting learning needs of users. Finally, MOOCs promise to address educational equity by helping students in developing countries access to high quality learning materials (Barclay & Logan, 2013).

In contrast to these optimistic predictions, recent reports indicated that the dropout rates for MOOC learners were high. Put simply, the visions of MOOCs as a provider for free or low cost learning resources for the masses have not yet been the reality. According to a survey conducted by Jordan (2013), the average completion rates for 91 MOOCs were 6.5%, and the

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enrolment numbers were decreasing over time after the courses launched. Furthermore, it was highlighted that the adoption of MOOCs has been relatively low especially in developing countries. Past reports found that learners in Asia, Africa, and Latin America are only half as likely to persist in MOOC learning than those in Northern America, Europe, and Oceania (Kizilcec & Halawa, 2015). In sum, even though MOOCs are considered desirable and potentially indispensable by educators, the adoption of MOOCs is not as prevalent as expected, especially in certain regions. Hence, understanding the drivers and barriers influencing MOOC adoption in those geographical areas will be insightful.

In research, there is still a paucity of literature which focused on adoption of MOOCs, especially for those in developing countries (Barclay & Logan, 2013; Liyanagunawardena, Adams, & Williams, 2013). The majority of the empirical research on MOOCs centered in more developed regions such as North America and Europe while the situation in the developing countries is somehow neglected (Veletsianos & Shepherdson, 2016). Indeed, understanding influential factors underlying adoption of MOOCs is significant for educators, universities, and MOOC enterprises. The insights gained would offer suggestions and guidelines to promote the diffusion of MOOCs among potential learners. Specifically, for learners from developing countries who are constrained by social and economic environments, understanding factors influencing the adoption of MOOCs are likely to aid in overcoming the potential barriers and promote the adoption of MOOCs which ultimately will help to bridge the digital divide (Liyanagunawardena, Adams, & Williams, 2013).

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Thus, the aim of the present study is to explore what factors influence the adoption of MOOCs in developing countries. More specifically, based on the domain of innovation and technological adoption research, the present study attempts to investigate the drivers and barriers of MOOC adoption in terms of technology characteristics, user factors, and social environmental factors, namely a Technology-User-Environment (TUE) perspective. Put differently, we propose that an integrated conceptual framework consisting of technological, user and social environmental factors from both adopters and non-adopters would be valuable. Hence, this research presents the following the research question: *What are the technological, user and social environmental factors that influence the adoption of MOOCs in a developing country?*

Literature Review**Research on MOOC Adoption**

Research on MOOC adoption can be classified into two streams: drivers and barriers. A variety of factors are found to be associated with learners' MOOC adoption, whereby some helps to facilitate the adoption of MOOCs while others prohibit this procedure (e.g., Hart, 2012; Hew & Cheung, 2014). In terms of driver studies, for instance, Kop (2011) concluded that self-directed ability, critical literacy, and social presence of instructors and participants could encourage individuals' involvement and engagement in online learning activities. Through crawling data from 44 MOOCs, Evans et al. (2016) identified that characteristics of learners and lectures were related to adoption and persistence of MOOC learning. Similarly, Pursel (2016) found that video views and participating in pre-course survey were strong predictors of MOOC completion.

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Meanwhile, another group of scholars focused on exploring the barriers of MOOC adoption. For example, Fini (2009) found that time constraints, technology skills and language problems were the main barriers that affected learners’ adoption of MOOCs. Hew and Cheung (2014) conducted a literature review to explore the reasons why students signed up and dropped out MOOCs. They suggested that the reasons for dropping out include lack of incentive, failure to understand the content, lack of instructions, and having other priorities. Through analyzing secondary data collected in a MOOC platform, Semenova and Rudakova (2016) identified three types of barriers related to educational experience, including the subject knowledge, the level of education, and the previous experience with MOOCs.

There are several weaknesses that need to be noted with previous MOOC adoption research. Firstly, most studies only focused on analyzing the participants of MOOCs either by online survey distributed through MOOC platforms (e.g., Kop, 2011) or secondary data crawled from these platforms (e.g., Evans, Baker, & Dee, 2016; Semenova & Rudakova, 2016), but neglected the non-adopters who never participate MOOC learning activities before. This may introduce the bias to their findings, especially for studies that investigated barriers of MOOC adoption, because non-adopter category would shed light on the barriers of MOOC usage. Secondly, learners from developing countries are often ignored in MOOC adoption research, though they are supposed to be the major beneficiaries by learning MOOCs (Barclay & Logan, 2013). As mentioned above, the number of MOOC learners in developing countries is much less than that in developed countries. Thus, research should pay more attention on issues in developing countries to address concerns on digital divide and educational equity. Hence, this

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research addresses these issues by focusing on both adopters and non-adopters of MOOCs in a developing country.

In sum, MOOC is regarded as an educational innovation (Kennedy, 2014) and educational innovation is an example of innovation in general (Rogers, 2003). Thus, studying MOOC adoption through the lens of innovation adoption research will be able to shed light in the adoption of MOOCs.

Innovation Adoption Research

Innovation adoption research has a longstanding and critical topic in the fields of information management (Claudy, Garcia, & O'Driscoll, 2014). Numerous studies have concentrated on the investigations of drivers or motivators of innovation adoption, and a number of behavioral theories have been widely applied to investigate this topic (for a review, see Venkatesh et al., 2003). These theories have been found to be applicable to explain a variety of innovations, ranging from new technologies (e.g., computer, smart phone) to technological services (e.g., mobile services, internet banking).

On a separate but related stream of work, some scholars focused on exploring the barriers that prevent individuals from adopting innovations. They argue that there is a "pro-innovation bias" in the innovation adoption research whereby innovations are always assumed to be superior and should be adopted by people (Ram, 1987; Rogers, 2003). Considering the high failure rate of innovations, it is necessary to investigate barriers to adoption (Claudy, Garcia, & O'Driscoll, 2014). In addition, it has been argued that barriers of innovation adoption are not the obverse of drivers of innovation adoption (Ram, 1987). Innovation barriers usually takes place even before

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drivers of adoption are activated (Laukkanen, Sinkkonen, & Laukkanen, 2008). Because innovations may bring changes to consumers, and resistance to change is a typical and normal response of consumers, which needs to be managed before adoption takes place (Kleijnen, Lee, & Wetzels, 2009; Ram, 1987).

Traditional innovation adoption studies have been criticized for mainly focusing on the “drivers” perspective but the neglecting the “barriers” perspective (Laukkanen, Sinkkonen, & Laukkanen, 2008; Ram & Sheth, 1989). Numerous studies have focused on the drivers motivating users to adopt innovations, while few studies paid attention to the barriers that prevent users from adoption (Kleijnen, Lee, & Wetzels, 2009; Lian & Yen, 2014; Ram, 1987). Some studies summarized the drivers and barriers of MOOC adoption through literature review, but without any empirical analysis (e.g., Hart, 2012; Hew & Cheung, 2014). As argued above, drivers and barriers of adoption are conceptually different, and they exert influence on individuals’ adoption decision in dissimilar approaches (Claudy, Garcia, & O’Driscoll, 2014). Hence, understanding barriers to adoption are also important.

Furthermore, it is noted that most of previous innovation adoption research has been conducted in the work environment whereby the adoption of innovative technology is mainly dependent on the decisions of the organizations rather than individual employees’ voluntariness (Venkatesh, et al., 2003). Thus, the findings derived from the work environment may not be completely applicable to explain factors underlying adoption of MOOCs (Laukkanen, Sinkkonen, & Laukkanen, 2008) which is outside the work environment. More specifically, such

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adoptions are driven mostly based on learners' voluntariness, their self interests and motivations, and time schedule (Means, et al., 2009).

To address these weaknesses, this study seeks to analyze both drivers and barriers from three dimensions: the technological characteristics, user factors and the social environmental factors. Such an integrated perspective will provide a comprehensive understanding of the influential factors underlying adoption of MOOCs.

A Technology-User-Environment Perspective

Previous studies have identified a variety of factors concerned with MOOC adoption, but lack a systematic framework to integrate them together. For instance, based on a literature review, Hart (2012) summarized the influential factors affecting learners' usage of MOOCs, including facilitators (e.g., flexibility, self-efficacy, social connectedness, support, etc.) and barriers (e.g., computer skills, accessing resources, isolation, poor communication). Similarly, Hew & Cheung (2014) listed potential motivations and challenges faced by learners through review previous studies, and found that motives for using MOOCs include increasing knowledge, getting certificate, and curiosity, while challenges come from lack of incentive, poor interaction, insufficient support, and so on. It is noted that a variety of factors has been discussed in the literature, but are inconsistent in terms of naming and grouping. Thus, one objective of the present study is to propose a theoretical framework to classify these influential factors into three dimensions. Specifically, we propose an integrative conceptual framework from the following three dimensions: technology, user and environment (TUE).

Our integrated conceptual framework is extended from the technology-organization-environment (TOE) framework (Tornatzky & Fleischer, 1990), which is a widely applied theoretical framework to investigate the adoption of technological innovations in an organizational context. It takes into account factors derived from technological, organizational, and environmental circumstances in an organization context. Here, (a) technological circumstance indicates how technology characteristics, including both existing and new technologies, may exert influence on adoption decision, (b) organizational circumstance describes how organization features, such as size, scope, resources, impact application of innovative technology, and (c) environmental circumstance refers to the influences from external sources like competitor, policy maker, market and so on (Zhu & Kraemer, 2005). The TOE framework has been applied to explain different types of technological innovation adoption.

It should be noted that the “organization” dimension in TOE would be replaced by “user” in the consumer environment. Because the TOE framework examines innovation adoption in an organization whereby the adoption decision is under the regulation and supervision of the managers, while the TUE framework attempts to explain innovation adoption at individual users’ level where adoption decision is made by themselves on the basis of voluntariness. In other words, the scenario where theses frameworks are applied are distinct. Considering there are abundant of self-service technologies and applications provided to users through internet and smart phone platforms, it is necessary to take the users’ own characteristics and perceptions into consideration, rather than the organizational forces and pressure.

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The relevance of the TUE perspective to alternative theoretical perspectives should be highlighted. First, it should be noted that the classification of TUE framework of is consistent with the innovation diffusion theory (Rogers, 2003) which also examines innovation diffusion from the perspectives of technology, users, and external environment. However, innovation diffusion theory mainly focuses on the drivers of innovation adoption. Second, Ram (1987) proposed a model to explain innovation resistance which classified influential factors into three categories namely innovation characteristics, consumer characteristics, and propagation mechanisms. Particularly, this model mainly investigated the barriers and obstacles of innovation adoption. Indeed, it has been identified that the drivers and barriers of innovation adoption are distinct qualitatively, and the mechanism in which they exert influence on users are also different (Claudy, Garcia, & O'Driscoll, 2014; Kleijnen, Lee, & Wetzels, 2009). Yet, research on both drivers and barriers of MOOCs is still limited. Thus, the present study intends to investigate both drivers and barriers in the proposed TUE framework.

For the drivers and barriers involved in the TUE framework, it is necessary to consider the specific contexts, for potential factors impacting innovation adoption are not consistent across different innovations, users and social contexts (Nguyen, 2008). Drawing from past innovation research and the TUE framework, this study explored the drivers and barriers by investigating (1) technological characteristics of MOOCs regarding perceived usefulness, performance-to-cost value, interactivity, and accessibility; (2) user factors in terms of self-regulation, experience of online learning, and gender; (3) social environmental factors concerned with learning tradition, peers' impact, instruction and publicity.

Technological Characteristics of MOOCs

Characteristics of innovation are deemed to have critical influence on individuals’ adoption decision (Ram, 1987; Rogers, 2003). Rogers (2003) summarized key innovation characteristics that can impact the innovation diffusion process and they include relative advantage, compatibility, complexity, trialability, and observed effects. However, as Rogers himself (2003) argued, these characteristics are derived from agricultural innovations and need to be adapted and changed according to specific innovations. In the context of MOOCs, we further proposed to examine perceived usefulness, performance-to-cost value, interactivity, and accessibility of MOOCs. We argue that these important characteristics of MOOCs are likely to influence users’ adoption.

Perceived Usefulness. Perceived usefulness refers to “the degree to which a person believes that using a particular system would enhance his or her job performance” (Davis, 1989). This is relevant in the context of MOOC adoption because learners will likely to use MOOCs only if they believe that MOOCs are likely to help with their learning performance. Indeed, MOOCs can benefit learners’ academic performance, especially for learners who have limited access to good-quality educational resources in developing countries (M. Zhou, 2016). In addition, it has been identified as strong predictor of learners’ intention to adopt MOOCs (Gao & Yang, 2015). Thus, perceived usefulness is likely to motivate learners to adopt MOOCs in developing countries. So we propose that:

H1: Perceived usefulness is positively associated with intention to adopt MOOCs.

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Performance-to-cost Value. The performance-to-cost value is based on the consumers' comparison between benefits and costs brought by the innovations (Rogers, 2003). If an innovation cannot offer higher performance-to-cost value than its substitutes, it is not worthwhile for individuals to change their established habits (Ram & Sheth, 1989). Learners may evaluate whether it is worthy of the expenses and efforts put in learning MOOCs especially when the learners have to spend money to access the content. In addition, learners from developing countries may be concerned with the monetary expense or the infrastructure cost required to access the content even if the access is free of charge. Hence, if the benefits outweigh the costs, learners are likely to adopt. Therefore, it is hypothesized that:

H2: Performance-to-cost value is positively associated with intention to adopt MOOCs.

Interactivity. Interactivity refers to direct communication and social interaction with the online community, which is one of the prerequisites for active learning (Kop, Fournier, & Mak, 2011). The interaction with the lectures and other participants is very critical in an online learning community, as it can create a sense of belonging and stimulate interactivities (Kop, 2011). However, MOOC learning is criticized to be lack of interactivity (North, Richardson, & North, 2014). This is because there are usually thousands of registered learners to study together and learners are not familiar with each other (Kennedy, 2014). Further, individual learners are not able to get adequate feedback during the learning process since there is a lack of reviewing and grading systems for some courses in MOOCs (North, Richardson, & North, 2014). In addition, as most MOOCs are taught and discussed in English, language might become an obstacle for non-native English speakers who are likely to be less interactive as they are likely to

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experience more challenges in interacting with the instructor and other learners. In other works, lack of interactivity may negatively influence intention to adopt MOOCs for learners in developing countries. Thus, we hypothesize that:

H3: Lack of interactivity is negatively associated with intention to adopt MOOCs.

Accessibility. For learners who are living in developing countries, access to MOOCs is a challenge. Learners in developing countries are constrained to access MOOCs due to the lack of internet access in some regions. Specifically, learners in many developing countries where the official and native language is not English will find it challenging to learn in MOOCs if the content is delivered in English. Due to this reason, MOOC learners are mainly located in Northern America, Europe, and Oceania rather than Asia, Africa, and Latin America (Kizilcec & Halawa, 2015). Collectively, accessibility issues may prevent learners from adopting MOOCs. Here, it is stated that:

H4: Lack of accessibility is negatively associated with intention to adopt MOOCs.

Users Factors

Semenova and Rudakova (2016) suggested that factors pertaining to the users should be taken into consideration when analyzing adoption of MOOCs. Indeed, it has been widely accepted that users play important roles in the adoption of an innovation (Rogers, 2003). Furthermore, it has been established that factors such as individual perceptions play important roles in technology-mediated learning (Lee et al., 2009). Since MOOC is considered to be an innovative technological platform for learners, it is thus important to consider the users'

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characteristics in this research. Three factors were identified for this research and the factors are self-regulation, past experience of online learning, and gender.

Self-regulation. Self regulation refers to individuals' ability to control goals setting, task strategies, time management and environment structuring, which help individual learners to succeed in their learning process (Onah & Sinclair, 2016). Learners who exhibit the ability of self-regulation perform better during the learning process, for self-regulated learners tend to be more confident, diligent, and persistent (Onah & Sinclair, 2016). The use of self-regulation strategies was also found to be associated with higher learning satisfaction (Q. Zhou, Lee, & Sin, 2017). In the online learning environment, it has been identified that the low completion rate of MOOCs is partly attributed to the lack of self-regulation or procrastination of learners (Barnard et al., 2009). Students who lack self-regulation abilities may be easily distracted by other things (e.g., online games), and feel frustrated if they cannot accomplish the online learning tasks as planned. As a result, they may be less willing to adopt MOOCs as a learning approach.

Therefore, it is hypothesized that:

H5: Self-regulation is positively associated with intention to adopt MOOCs.

Experience. Prior experience of online learning has also been identified as an important predictor of MOOC adoption. Semenova and Rudakova (2016) found that previous experience with online learning can significantly affect learners' adoption and persistence in MOOCs. This is because learners with experiences are more confident with the online learning environment and are likely to be engaged in online learning activities (Koutropoulos et al., 2012). Thus, we state that:

H6: Experience with online learning is positively associated with intention to adopt MOOCs.

Gender. Gender was found to be influential in learners’ online learning performance (Kizilcec & Halawa, 2015; Semenova & Rudakova, 2016). Past research has reported that men’s completion rate of MOOCs is higher than women (Semenova & Rudakova, 2016). One possible explanation is that women need to devote more time on other important obligations (such as household duties). In addition, women’s persistence and performance in online learning is lower than men (Kizilcec & Halawa, 2015). Hence, we propose that:

H7: Gender can significantly influence intention to adopt MOOCs.

Social Environmental Factors

Research on the adoption of information technology has identified that the social environment factors play significant influence in the adoption decisions (Venkatesh, et al., 2003). Likewise, research on learning in social media has also emphasized the importance of the social environmental factors in influencing learners’ attitude towards learning in such social platforms (Yu et al., 2010; Q. Zhou, Lee, & Sin, 2016). In addition, Semenova and Rudakova (2016) argued that contextual factors should be taken into consideration when analyzing adoption of MOOCs. Here, we examine influential factors of social context in terms of learning tradition, peer’s impact, instructions, and publicity. These factors are discussed as follows.

Learning tradition. Traditions and norms refer to “inherited body of customs and beliefs within a relevant social context” (Kleijnen, Lee, & Wetzels, 2009). Tradition is deemed as one of the major barrier to innovation adoption, for tradition can shape individuals’ stereotyped thinking

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(Ram & Sheth, 1989). Any change contrary to tradition or habits will trigger individuals' resistance towards innovation. In the education field, learners are used to the traditional classroom environment where they are grouped according to age and class (Kop, Fournier, & Mak, 2011). Compared to traditional learning environment, learners of MOOCs need to plan their own schedule, self-regulate the learning process, and study by themselves (Onah & Sinclair, 2016). These require learners to change their well-established routines and habits, which may trigger their resistance to learning MOOCs as a result. Thus, the following hypothesis is proposed:

H8: Learning tradition is negatively associated with intention to adopt MOOCs.

Peers' impact. Influence derived from peers can significantly determine individuals' innovation adoption decisions (Rogers, 2003; Venkatesh, et al., 2003). Lee et al. (2017) also highlighted that the online learning environment needs to include social support and interaction from the peers as learning is a social experience. Particularly, peers' support is important for a novice learner in an autonomous learning environment (Kop, Fournier, & Mak, 2011). Peers facilitate the learning process as they provide the social interaction needed for the learners (Kop, Fournier, & Mak, 2011). If there is a lack of support from peers, it is likely that learners will find the environment to be not conducive and hence will not adopt MOOCs. Indeed, the peers are critical to create a positive social learning environment for the entire community (Lee, et al., 2017). Therefore, it is stated that:

H9: Peers' impact is significantly associated with intention to adopt MOOCs.

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Instruction. As MOOC learning takes place in an autonomous online environment, it is important for learners to get instructions of how to study with MOOCs (Kop, Fournier, & Mak, 2011). It is found that novice users tend to feel uncomfortable with self-service technology, and need instructions from facilitators to overcome the initial barriers (Laukkanen, Sinkkonen, & Laukkanen, 2008). As a type of self-service technology, MOOC learners should get necessary instructions at the very beginning. However, based on the observations and literature, there is a lack of instructions for novice learners of MOOCs, either from schools or MOOC content provider. This may result into the non-adoption of MOOCs. Here, we state that:

H10: Lack of instruction is negatively associated with intention to adopt MOOCs.

Publicity. Propagation or publicity is critical for the success of an innovation (Ram, 1987). Before adoption happens, it is necessary to let potential users know the innovation. In the case of MOOCs, it is the responsibility of MOOC content provider to promote the diffusion of MOOCs through advertisements or road shows on campus. However, the publicity of MOOC learning is still not enough. Especially in developing countries and regions, some students have never heard of MOOCs or are not informed on how to access the information resources to seek for suitable courses (Ma & Lee, 2017). This may further prevent potential learners from adopting MOOCs. So it is hypothesized that:

H11: Lack of publicity is negatively associated with intention to adopt MOOCs.

In sum, the proposed theoretical framework in this study is summarized in Figure 1.

<Insert Figure 1 here >

Methodology

Participants and procedure

In order to test the proposed hypotheses, the present study conducted a survey in China. Despite having the world's second-largest economy, China is still considered a developing country. We chose to conduct our study in China because of the following reasons. First, China is regarded as one of the largest market for educational innovation, as there are more than three hundred millions students in nearly three thousand universities. Second, the need to access high quality learning materials for higher education learning is in demand in certain geographical regions in China as higher educational resources are not well-distributed across the country. Third, the popularity of MOOCs in Chinese universities is growing. As such, MOOCs will be playing important roles in the learning journey of many Chinese students.

A self-administered questionnaire was applied to collect the primary data. The data was collected both through online and offline approaches. It should be noted that to minimize any selection biases, research participants were recruited from different regions and universities in China. All participants were briefed about the purpose of the research and provided with relevant information in terms of privacy and confidentiality. In all, 827 questionnaires were collected from both online and offline surveys. 271 (32.8%) of the participants were male and the rest (67.2%) were female. Majority of the participants were students (94.6%) while the rest have graduated and were working professionals (5.4%). Among the responses, 240 (29%) of them indicated that they had used MOOCs before and would like to continue to use, who were

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regarded as “adopters” of MOOCs. The rest (71%) were “non-adopters” who either had not tried MOOCs before or decided not to use in the future.

Measurements

The measurements of the questionnaire were all adapted from previous studies. For instance, the measurements of perceived usefulness, accessibility, peers’ impact, instruction are adapted from the study of Venkatesh, et al.(2003), performance-to-cost value, interactivity, and learning tradition are derived from Lian and Yen’s (2014) research, self-regulation from Tangney et al. (2004) and publicity from Novak & Hoffman’s (1997). In all, 25 questions were used to measure these constructs, following a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

After collecting the data, the reliability and validity of the measurements were accessed. To test the reliability of the measurements, we calculated the Cronbach’s alpha values for all the measurements and found that all the values were acceptable (larger than 0.6). Furthermore, principal component factor analysis with Varimax rotation was used to test the validity of all the constructs in the conceptual model. One question item of accessibility measurement was deleted due to the issue of low loading (0.5 or below). It was found that the measurements of learning tradition and peers’ impact as well as instruction and publicity were loaded together. This indicates that the constructs were highly interrelated. Indeed, past research has suggested that peers’ impact is related to traditions and social norms (Kleijnen, Lee, & Wetzels, 2009). Hence, it is likely that in MOOCs, these factors have intertwining effects and would be difficult to differentiate. As a result, learning tradition and peers’ impact were combined together to reflect

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the influence of traditions and social norms in education. Likewise, instruction and publicity were combined together, reflecting the information and awareness of MOOCs provided by both universities and content providers. Correspondingly, the hypotheses are revised as:

H8/9: Tradition and social norms are significantly associated with intention to adopt MOOCs.

H10/11: Lack of information about MOOCs is negatively associated with intention to adopt MOOCs.

Data analysis

For data analysis, hierarchical regression was performed to analyze the primary data. Hierarchical regression is able to separate the independent variables into different blocks and further manifest the influences of each block on dependent variable (Petrocelli, 2003). As the independent variables in this study were separated into three groups (i.e., innovation characteristics, user factors, and social environment), each group's influence can be uncovered and compared through hierarchical regression analysis. Specifically, user factors were entered as the first block, followed by MOOC characteristics as the second block and social environmental factors as the last one. Statistical significance was set at the .05 level.

Findings

The analysis results of hierarchical regression are presented in Table 1. All the independent variables entered in the model accounted for 36.7% of the variance in predicting the intention to adopt MOOCs (adjusted $R^2=.367$, $F=54.22$, $p<0.001$). This indicates that the entire conceptual model is statistically significant.

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<Insert Table 1 here>

In the first block, factors related to users are entered. Results indicate that that self-regulation and gender were both significant. It is noted that self-regulation ($\beta = 0.366, p < .001$) shows the strongest relationship with intention to adopt MOOCs, which indicates that learner who can well regulate their learning process are more likely to adopt MOOCs. In addition, gender ($\beta = -0.094, p < .01$) was also identified to play an important role. As female is coded as 1 and male as 2, the positive coefficient means that females are more likely to adopt MOOCs in their learning. However, past experience of online learning was found to have no significant relationship with learners' intention of MOOC adoption. In all, these factors explain 12.7% of the variance in intention to adopt MOOCs (adjusted $R^2 = 0.127, F = 41.0, p < 0.001$).

In the second block, innovation characteristics are added into the model. The revised model was still significant (adjusted $R^2 = 0.358, F = 66.7, p < .001$). Among these characteristics regarding innovation, perceived usefulness ($\beta = 0.321, p < .001$) was the most significant determinant of intention to adopt MOOCs. That is, learners who perceive MOOCs to be useful are more likely they are to adopt this educational innovation. Performance-to-cost value ($\beta = 0.141, p < .001$) was also significantly related with intention to adopt MOOCs. In addition, It is found that lack of accessibility ($\beta = -0.163, p < .001$) was significantly associated with intention to adopt MOOCs. In contrary to expectation, lack of interactivity ($\beta = -0.09, p = 0.320$) shows no significant relationship with intention of MOOC adoption. The adjusted R^2 increased by 23.1%. This means that, characteristics of MOOCs can significantly increase the explanation power of the conceptual model.

In the third block, social environmental factors were integrated into the model. We found tradition and social norms ($\beta = -0.072$, $p < .05$) to be negatively associated with learners' intention of MOOC adoption. So H8/9 is supported. In addition, lack of information about MOOCs ($\beta = -0.121$, $p < .001$) showed significant influence on learners' intention to adopt MOOCs. After adding factors derived from social environment, the entire model is still significant (adjusted $R^2 = 0.367$, $F = 54.2$, $p < 0.001$). The adjusted R^2 is increased only by 0.9% compared to model 2, which means that the influence derived from social environment is slight and limited.

Discussion

The purpose of this study is to investigate factors underlying the adoption of MOOCs. The conceptual model explored the influential factors from three perspectives, including technological characteristics of MOOCs, user factors and social environmental factors. The entire model was found to be significant in explaining intention of MOOC adoption.

In terms of user factors, self-regulation was found to exert the strongest influence on learners' intention to adopt MOOCs. Indeed, individuals need to be self-motivated to direct their own learning process in the autonomous online learning environment (Kop, 2011). Since there are many distractions in an online environment (such as checking updates in social media, watching videos, playing online games, and so on), it is necessary for learners to regulate and control their own leaning activities (Onah & Sinclair, 2016). Lack of self-regulation may lead to failure of MOOC learning and further discourage them from adopting MOOCs. Interestingly, this study finds that female learners are more likely to adopt MOOCs than male learners. It is possible that female learners tend to devote more effort to improve their academic performance

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(Fischer, Schult, & Hell, 2013) because they are more motivated and as such are able to self-regulate their learning process more effectively than their male counterparts. Consequently, they are more likely to adopt MOOCs as an efficient way to meet their learning needs.

Regarding characteristics of MOOCs, it is not surprising to find that perceived usefulness was ranked as the most influential determinant of MOOC adoption. As there are a variety of course choices ranging from social science (e.g., arts, history, humanity) to natural science (e.g., physics, chemistry, mathematics), learners are able to look for course materials to suit their needs. Access to online educational resources is particularly valuable to learners who are located in the developing country. Specifically, these learners can utilize the resources improve their academic performance at school or strengthen their professional skill at work. Furthermore, performance-to-cost value is a critical factor when learners consider to adopt MOOCs. As MOOCs are usually designed to be short and easy to understand, it is very efficient to help learners to study knowledge or solve their problems. Learners tend to believe that MOOC learning is worthy of money, time, and effort they spend, which in turn contributes to the adoption of MOOCs. However, lack of accessibility is regarded as a major barrier to adopting MOOCs. Due to the language problem, learners whose native language is not English may find it difficult to follow the MOOCs since the courses are mostly delivered in English. Meanwhile, learners in developing countries may also experience problems connecting to the internet due to the inadequate or unstable network facilities. For these reasons, there are fewer MOOC learners in developing regions such as Asia and Latin American (Evans, Baker, & Dee, 2016; Kizilcec & Halawa, 2015).

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In terms of the social environmental factors, lack of information about MOOCs was found to be an obstacle to promote learning in MOOCs. Past works have explained that individuals tend to feel uncomfortable when using self-service technology may encounter obstacles and frustrations at the beginning (Laukkanen, Sinkkonen, & Laukkanen, 2008). This may also take place in the process of learning MOOCs which should also be regarded as a type of self-service technology. For this reason, it is very important to provide instructions to facilitate learning in MOOCs especially at the start of the learning process. Our results suggest that promotional and marketing efforts are needed by the different stakeholders to raise awareness of MOOCs and let potential learners get to know the benefits and advantages of learning MOOCs. It has been criticized that educational innovations always emphasize the efficiency of techniques but overlook the process and purpose of education (Nisbet & Collins, 1978), which needs to be carefully looked into by educators and administrators of MOOCs. In addition, tradition and social norms seem to exert negative influence on learners' MOOC adoption here. As students may be used to learning under the instruction of lecturers and discussing with their fellow learners, the new learning approach introduced by MOOCs may disrupt their established habits and study routines. For these reasons, they may resist the adoption of MOOCs.

Furthermore, according to our results, MOOC characteristics contributed most to the explanation of adoption intention of learners while factors derived from social environment contributed the least. That is, the characteristics of MOOCs (e.g., perceived usefulness, performance-to-cost value, accessibility) are the main factors to influence learners' decision of adopting this educational innovation. Factors derived from social environment were found to be

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less influential in affecting learners’ intention. That is partly because learning in MOOCs is a relatively independent activity, which mainly depends on learners’ own willingness and ability of self-regulation rather than the environmental factors as long as they have access to the internet.

Conclusion

The findings of this study contribute to the innovation research in several aspects. Firstly, the present study proposes a conceptual framework, namely Technology-User-Environment (TUE), to investigate both drivers and barriers of MOOC adoption. Influential factors are examined in three different perspectives, including innovation characteristics, user factors and social environmental factors, which provide a comprehensive understanding of MOOC adoption. Future studies may explore the relationships between variables identified in the TUE framework for other technological innovations in the consumer environment. Secondly, by conducting hierarchical regression analysis, it was found that the technological characteristics of MOOCs contributed most to the explanation of MOOC adoption, followed by user factors and social environmental factors. Last but not least, this study was conducted in China which provides an Asian context and as such the findings provide a complementary and comparison Eastern perspective to western-centered context in most MOOC adoption studies.

For practices, there are some suggestions for different stakeholders of MOOCs. First, for MOOC content provider, it is necessary to enhance the usefulness of MOOCs, as perceived usefulness is ranked as the strongest predictor of MOOC adoption. Beyond higher education, MOOC content provider can provide skill-based course materials to facilitate the life-long

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learning process. Specifically, MOOCs can play important roles in terms of supporting professional development and career advancement by providing useful courses in these areas to their users. Second, universities should help students overcome the potential obstacles at the beginning of MOOC learning by providing instructions to learners to search for course materials and how to use MOOCs to supplement their formal learning. Such information is meaningful as it helps to anchor what is already known by the learner (Ausubel, 1978). Third, universities should collaborate with MOOC content provider to promote this new learning approach on campus regularly, such as organizing some lectures and tutorials. For users, they should be equipped with self-regulating strategies so that they will be competent to manage challenges (e.g. distractions) while learning in MOOCs.

There are some limitations in this study that could be addressed in future work. First, as the data were collected only in one developing country, it should be cautious when generalizing the findings to other developing countries. Second, there may exist some relationships among the variables proposed in the conceptual framework, as the present exploratory study did not consider the potential interacting effects. Third, the current study was based on a cross-sectional design. Future research may include collecting multiple stages of data in order to test longitudinal models with cross-lagged effects, especially in the case of users who managed to overcome their initial difficulties with MOOCs. Despite these limitations, this study remains important as it contributes to the body of knowledge of MOOC adoption especially in the context of a developing country.

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Practitioner Notes

What is already known about this topic:

- MOOCs (Massive Open Online Courses), as educational innovations, are supposed to bridge the digital divide and promote educational equity globally.
- The benefits of MOOCs for learners are obvious.
- However, the adoption rate of MOOCs is still relatively low while the dropout rate is high, especially in developing countries.
- Research on the adoption of MOOCs in developing countries is still limited.

What this paper adds:

- This research proposed a conceptual framework, namely Technology-User-Environment (TUE), in order to identify influential drivers and barriers from the technological characteristics of MOOCs as well as the user and the social environmental factors.
- After conducting a survey among 827 learners in a developing country, it was found that perceived usefulness of MOOCs, performance-to-cost value, self-regulation are positively associated with learners' intention of adopting MOOCs, while lack of accessibility tradition and social norms, and lack of supporting information are negatively associated with their intention of MOOC adoption.

Implications for practice and/or policy:

- For MOOC content provider, it is necessary to enhance the usefulness of MOOCs, as perceived usefulness is ranked as the strongest predictor of MOOC adoption.

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- Universities should help students overcome the potential obstacles at the beginning of MOOC learning by providing instructions to learners to search for course materials and how to use MOOCs to supplement their formal learning.
- For learners, they should be equipped with self-regulating strategies so that they will be competent to manage challenges (e.g. distractions) while learning in MOOCs.

Figure 1. A Technology-User-Environment (TUE) Conceptual Framework

270x140mm (96 x 96 DPI)

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Tables

Table 1. Hierarchical Regression Analysis (N=827)

Independent Variables	Standardized Beta	t-values	Adjusted R ²
<i>First block: User factors</i>			
Self-regulation	.366	11.044***	.127***
Gender	-.094	-2.844**	
Experience	-.006	-.178	
<i>Second block: MOOC characteristics</i>			
Perceived Usefulness	.321	9.158***	.358***
Performance-to-cost value	.141	4.274***	
Lack of Interactivity	.009	.320	
Lack of Accessibility	-.163	-4.761***	
<i>Third block: Social environmental factors</i>			
Tradition and social norms	-.072	-2.324*	.367***
Lack of Information	-.121	-3.532***	

Note: a. dependent variable is “intention of MOOC adoption”.

b. *p< .05, **p < .01, *** p< .001