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Assessing the Psychometric Properties of Students' MOOC-Efficacy Measurement Model

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ABSTRACT

Massive Open Online Courses (MOOCs) have been identified as a potential innovation for improving teaching and learning. This research aims to develop and evaluate a measurement model of students' MOOC-efficacy. The study conceptualized students' MOOC-efficacy in four dimensions of information searching, making queries, MOOC learning, and MOOC usability. Data were collected with a 23 items questionnaire whose reliability indexes ranged from 0.822 to 0.890, identified from university students who have had some experience with MOOCs and who willingly volunteered to participate in the research (N=1,524). A sample of 623 respondents was drawn through simple random sampling. The Confirmatory Factor Analysis (CFA) was adopted for data analysis. The findings designate that four-dimensional students' MOOC-efficacy measurement model achieved an acceptable level of fit (RMSEA = 0.061, CFI = 0.935 and a normed chi-square, $\chi 2/df = 3.322$). All statistics provide empirical evidence that the students' MOOC-efficacy measurement model is psychometrically sound in terms of validity and reliability. The measurement model of students' MOOC-efficacy provides further insights into what works in an open online environment which may be used to fulfill learners' needs and preferences.

Keywords: Confirmatory Factor Analysis (CFA), measurement model, MOOC-efficacy, reliability, validity

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INTRODUCTION

The increasing use of e-learning in advanced higher education has led to the establishment of Massive Open Online Courses (MOOCs), a learning platform that is fast attracting global attention. The concepts of e-learning, online learning, distance learning and open learning pioneered the development of MOOCs (Goh, 2017; Zawacki-Richter et al., 2018). MOOCs, an innovation in web-based learning, are an alternative way of delivering interactive teaching and learning to students that poses an enormous challenge to the traditional classroom. "Massive" denotes an unlimited offering of courses, materials and learners, "open" means that the courses are open to participation from a large number of geographically dispersed students. Online courses are those that deliver teaching and learning on the Internet (Jansen & Konings, 2017). MOOCs have been hailed as a potential rejuvenation in instructional technology that responds to the technologically driven environment of 21st century education and industrial revolution 4.0 (Rose Alinda et al., 2017).

In Malaysia, MOOCs are a recent phenomenon in online learning that fall in tandem with two important national plans. First is the Malaysia Education Blueprint for Higher Education (2015-2025) which outlines ten shifts that will spur continued excellence in the nation's higher education system. All ten shifts address key performance issues fundamental to achieving Malaysia's aspiration to provide her citizens with better access to quality education. Shift Nine mentioned in the blueprint describes Malaysia's aspiration to establish Global Online Learning (GOL) (Ministry of Education, 2015), and one of the indicators to determine the achievement of GOL is the establishment of Massive Open Online Courses. MOOCs aim to make online learning an integral component of higher education and lifelong learning, starting with the conversion of common undergraduate courses into MOOCs, and requiring up to 70% of the programmes to use blended learning models.

The second important national plan which encourages MOOC development is the National Economic Model and Economic Transformation Program (11th Malaysia Plan, 2016-2020). In the 11th Malaysia Plan, the focus is to improve the quality of education for better student outcomes and to strengthen the role of higher learning institutions (HLIs) as a conduit for innovation by encouraging the launching of MOOCs. In Malaysia, the government has launched MOOCs in niche areas of expertise to make online learning an integral component of teaching and learning in higher education. It provides support for eligible HLIs in establishing the required cyber infrastructure in areas where none has existed yet (Ministry of Economic Affairs, 2015). Furthermore, MOOCs also support high impact educational practices in the curriculum implementation in higher education (Ghazali et al., 2020).

MOOCs are still at an early stage of implementation in Malaysia. All MOOCs in Malaysia are offered through Open Learning. In this regard, MOOCs are

now considered as an essential medium for Malaysian universities to disseminate knowledge conveniently to a large number of students (Daneji et al., 2019; Habibah et al., 2016). MOOCs have been identified as a potential innovation for improving traditional teaching and learning in order to respond to the technologically-driven environment of 21st century education. Due to the recent development and exploratory nature of the MOOC initiative in Malaysia, it is clear that there are many issues to identify and gaps to close. Currently, gaps in the current MOOC initiatives show plenty of room for improvement (Ghazali & Nordin, 2016; Hudiya et al., 2017). Poor completion and high dropout rates were reported to be the main challenges of MOOCs, both locally and internationally (e.g. Almahdi & Sulfeeza, 2017; Goh, 2017; Hakami et al., 2017). Nordin et al. (2015b) in their research on MOOC acceptance in Malaysia revealed that more than half of the students felt that they could not complete the tasks in MOOCs if no instructor was there to instruct and guide them. It was discovered that more than half of the students (50.9%) had low levels of MOOC efficacy and were not able to perform the learning tasks without explicit supervision.

One of the reasons why MOOCs had such low completion and high dropout rates could be the lack of development of positive self-efficacy beliefs among the course takers (Branson, 2017; Hodges, 2016; Wang & Baker, 2015). The findings revealed that students who completed the course tended to have higher self-efficacy beliefs. Basically in the Malaysian context, most studies on MOOCs concentrated on perceptions, acceptance and challenges (e.g. Abdul Rahman et al., 2015; Daneji et al., 2018, 2019; Fadzil et al., 2015; Ghazali & Nordin, 2016; Goh, 2017; Kruchinin, 2019; Nordin et al., 2015b), leaving much gap for a large exploration of self-efficacy in MOOCs (Almahdi & Sulfeeza, 2017; Ghazali & Nordin, 2016; Ghazali et al., 2020). Very limited research has been done to identify students' MOOC efficacy, develop MOOC-efficacy scales, and test measurement models related to MOOCs and the self-efficacy construct.

Based on the review on measures of students' self-efficacy in an online learning environment, there is relatively a lack of attempt to develop a valid instrument to measure students' self-efficacy specifically in the context of MOOCs. Most of the instruments focused on measuring students' self-efficacy in an online learning environment. The same problem exists in the measurement model of students' self-efficacy in MOOCs; this aspect seems to be neglected (Ghazali & Nordin, 2016; Willis et al., 2013). Based on the previous literature, self-efficacy seems to be a crucial factor that needs to be emphasized to improve MOOC implementation specifically in Malaysia. Moreover, research that involves model and scale development in MOOCs has been identified as crucial in order to improve MOOC implementation (Ghazali & Nordin, 2016; Zawacki-Richter et al., 2018). Due to the importance of self-efficacy beliefs in MOOCs (Branson, 2017; Wang & Baker,

2015) and the need for research on MOOC-efficacy in the Malaysian context (Almahdi & Sulfeeza, 2017), this research aims to develop and evaluate a measurement model on higher education students' MOOC-efficacy.

LITERATURE REVIEW

MOOCs at the Malaysian Higher Education Institutions

MOOCs are still at the early stage of their implementation in Malaysia, even though they have gained a lot of recognition in other countries especially the USA and the United Kingdom. Malaysia's first institution to launch a MOOC was Taylor's University in 2013. Taylor's University aims to give its faculty members the opportunity to explore new delivery methods through the use of technology (Digital News Asia, 2014). In September 2014, the Ministry of Education Malaysia introduced four courses in MOOCs with four universities elected as content designers for the Malaysian MOOC. The courses are foundation or compulsory courses that must be taken by undergraduates in Malaysian universities.

The instructors of all the four courses are free to plan their instructional processes by utilizing MOOCs in a blended learning mode, according to their respective universities (Ministry of Education Malaysia, 2015). Blended learning is a teaching practice that combines the traditional face-to-face mode of teaching with the web-based teaching and learning (Embi et al., 2014). This initiative is a collaborative effort of various parties at all levels with the aim to improve the quality of teaching and learning at Malaysian higher education institutes. All MOOCs in Malaysia are offered through Open Learning which is considered Malaysia's National MOOC platform. Continued growth in MOOCs was an essential part of the Ministry of Education Malaysia's strategic plan to increase the quality and accessibility of higher education in Malaysia. MOOCs have challenged universities to renew their focus on teaching and to upskill their course design teams to ensure that they can develop better MOOCs.

The significant increase in the number of MOOCs meant that more planning and coordinating among universities were needed. In spite of the new status of MOOCs in Malaysia, few studies have shown that MOOCs in Malaysia are likely to undergo various developments in the next several years. There are few studies on MOOCs in the Malaysian context that were aimed at improving the implementation of MOOCs in the country (Ghazali et al., 2020). Most of the studies were conducted to investigate perceptions of teaching and learning in MOOCs (e.g., Abdul Rahman et al., 2015; Fadzil et al., 2015; Ghazali & Nordin, 2016). Meanwhile, Nordin et al. (2016) and Habibah et al. (2016) conducted researches to examine factors for teaching and learning in the Malaysian MOOC. Findings revealed that 'content' was the major factor in predicting teaching and learning enhancement because it was considered to be a fundamental aspect in the success of MOOCs.

Fadzil et al. (2016) and Nordin et al. (2015b) sought to investigate the MOOC readiness level and technology acceptance of MOOCs in the Malaysian higher education institutions, respectively. The findings indicated that self-efficacy and self-directedness were significant for MOOC readiness (Fadzil et al., 2016). In terms of technology acceptance of MOOCs, Nordin et al. (2015b) revealed that students accepted MOOCs as a technology for learning and this conclusion was made based on the aspects mentioned in the Unified Theory of Acceptance and Use of Technology (UTAUT) model. The model includes five factors which are: 1) performance expectancy; 2) effort expectancy; 3) social influence; 4) facilitating conditions; 5) behavioural attention as well as three other Non-UTAUT factors: 6) attitude; 7) self-efficacy and 8) anxiety. One of the important findings indicated that more than half of the students who had a lower level of self-efficacy were not able to perform tasks in MOOCs without supervision.

A recent study conducted by Goh (2017), examined students' perceptions of their learning experience throughout a course in MOOCs. The research also discussed the effectiveness and challenges of MOOC learning. The findings revealed that the prime challenges of MOOC learning were the sustainability of course participants and their completion rates. The top five reasons discovered for not completing the course were the lack of time, poor internet connection, the loss of momentum as the course progressed, the difficulty in following the course in English language and the inability to search for relevant materials. Similar issues of dropout and low completion rates were also discussed in a study by Almahdi and Sulfeeza (2017) where a preliminary review of the challenges of MOOCs was conducted. The research identified factors that correlated with the likelihood of dropout rates and provided suggestions for improvement. The factors which were considered crucial for high dropout rates in MOOCs were the lack of time, student motivation, interactivity in MOOCs, the feeling of isolation, insufficient knowledge or skills and hidden costs. The research also highlighted the difficulties in determining MOOC-efficacy due to limited accessibility to all MOOC learners and thus recommended studying MOOC-efficacy in depth for future research.

MOOCs and Self-Efficacy

Although MOOCs are utilized throughout the world, they face two major challenges, namely poor completion rates (reported to be between 5% and 15%) and high dropout rates (Almahdi & Sulfeeza, 2017; Chiam, 2016; Goh, 2017; Greene, Oswald, & Pomerantz, 2015). One of the reasons why MOOCs had such low completion and high dropout rates could be the lack of development of positive self-efficacy beliefs among the course takers (Branson, 2017; Hodges, 2016; Wang & Baker, 2015). The relationship between student motivation and efficacy with the completion of MOOCs was examined by Wang and Baker (2015). The findings revealed that students who

completed the course tended to have higher self-efficacy beliefs. The same finding was revealed by Branson (2017) in his research on academic self-efficacy and MOOC completion rates among adult learners. Both researchers had concluded that self-efficacy beliefs were important to determine the success of MOOCs and gain higher completion rates.

In the Malaysian context, there is relatively little empirical research focusing on MOOC-efficacy, specifically in the Malaysian context. Most studies on MOOCs concentrated on perceptions, acceptance, challenges and factors for usage (Abdul Rahman et al., 2015; Almahdi & Sulfeeza, 2017; Fadzil et al., 2015, 2016; Ghazali & Nordin, 2016; Goh, 2017; Habibah et al., 2016; Nordin et al., 2015b; 2016), leaving a gap for a larger exploration of self-efficacy and MOOCs (Almahdi & Sulfeeza, 2017; Ghazali & Nordin, 2016). Fadzil et al. (2016) and Nordin et al. (2015b) in their research, underlined that self-efficacy was the most important factor that influenced readiness and acceptance of MOOCs in Malaysia. However, the number of items that measured self-efficacy in the context of MOOC readiness was only five (Fadzil et al., 2016) and there were only three items in the research on MOOC acceptance by Nordin et al. (2015b). Therefore, their research was inadequate to measure the construct of efficacy comprehensively especially, in the context of the Malaysian MOOC.

Previous scholars have recommended that future research focus on and investigate student's MOOC-efficacy for a variety of target audiences and contexts to develop a successful MOOC platform (e.g. Almahdi & Sulfeeza, 2017; Padilla Rodriquez & Armellini, 2017; Terras & Ramsay, 2015). Furthermore, a dearth of scholarly literature on MOOCs suggests that comparable models of educational research into MOOC-efficacy may help align the theory of participation with the empirical results of low completion rates in MOOCs (Willis et al., 2013). Based on the previous literature, students' MOOC-efficacy seems to be a crucial factor that needs to be emphasized to improve MOOC implementation in Malaysia.

Students' MOOC-Efficacy

Self-efficacy is a psychological construct, which discusses in general an individual's belief in his or her capability of handling particular tasks and challenges. This phenomenon basically involves human cognition; what an individual think about himself or herself. Recent developments in and the characteristics of MOOCs have led students to feel isolated, lonely and not connected (Almahdi & Sulfeeza, 2017; Kilgore & Lowenthal, 2015) thus, indicating the need for students to be responsible for their own learning and knowing their capabilities through the learning process in MOOCs (Fadzil et al., 2016; Nordin et al., 2015a). With reference to the previous discussion, students' self-efficacy is defined as a student's perception of his or her own ability to perform a specific task successfully (Bandura, 1986; Cartwright & Atwood, 2014; Padilla Rodriguez & Armellini, 2017). Students' MOOC-efficacy in the context

of this research refers to students' beliefs in their capabilities to perform a specific learning task in the context of MOOCs. Students in this research are referred to those students who are in the Malaysian Higher Education Institutions.

Due to the personalized learning environment in MOOCs, students have to recognize their capabilities to search for relevant information (Goh, 2017; Nordin et al., 2015a; Padilla Rodriquez & Armellini, 2017), seek academic help and pose questions during their learning process in MOOCs (Fadzil et al., 2016; Nordin et al., 2015a). Terras and Ramsay (2015) proposed that further insight be gained to examine internal factors such as students' efficacy, to understand learners' expectations and how they cope with specific challenges that are associated with MOOCs. Moreover, students' capabilities to learn in a MOOC environment and engage in MOOCs practically, are very important for the success of MOOCs (Almahdi & Sulfeeza, 2017; Fadzil et al., 2015, 2016; Nordin et al., 2015a, 2016).

Self-efficacy beliefs tend to be domain-specific and are best assessed in relation to specific skills (Wang & Baker, 2015). Every new or different-context task encountered by an individual initiates a formulation of self-efficacy beliefs regarding his or her performance of the task in that specific context (Hodges, 2016). The students' MOOC-efficacy construct and the underlying dimensions will be discussed in the next subtopic.

Dimensions of Students' MOOC-efficacy

Students' MOOC-efficacy in this research was measured and conceptualized in four dimensions: (i) information searching; (ii) making queries; (iii) MOOC learning and iv) MOOC usability, all of which were adapted from the Internet-Based Learning Environment scale (SIBLE) (Chen, 2014). Chen (2014) stood out as the most relevant to the present research in terms of providing a framework that could be a guide to measure the required aspects of students' MOOC-efficacy. Chen (2014) proposed that students' self-efficacy in internet-based learning environments (SIBLE) was a construct that comprised five dimensions. The SIBLE seems to be a promising scale to capture the elusive concept of students' self-efficacy, because it has good psychometric properties and assesses a wide range of competencies which are important for a virtual learning environment (Chen, 2014; Ching et al., 2014; Cheng & Tsai, 2011). SIBLE was developed from a combination of two survey instruments, one on online academic-help-seeking (OAHS) behaviour and the other, on web-based learning self-efficacy (WLSE). OAHS consists of 3 dimensions namely, information-searching, formal query and informal query. Meanwhile, the items on WLSE generally measure the integration of two concepts which are web-based learning and web-based usability function.

To further refine Chen's (2014) five dimensions of SIBLE, an extensive number of empirical studies on students' self-efficacy and MOOCs (Almahdi & Sulfeeza,

2017; Cartwright & Atwood, 2014; Fadzil et al., 2015; 2016; Ghazali & Nordin, 2016; Goh, 2017; Hodges, 2016; Nordin et al., 2015a; 2016; Padilla Rodriquez & Armellini, 2017) were reviewed. Based on this extensive review, information searching was adopted as the first dimension of the students' MOOC-efficacy construct in order to measure students' capabilities to search for relevant information (Goh, 2017; Nordin et al., 2015a; Padilla Rodriquez & Armellini, 2017). For the second dimension, the researcher decided to adapt and merge the formal and informal queries into a single dimension and term it as making queries. The formal query in SIBLE measures students' capabilities to ask instructors questions in an Internet-based learning platform, while the informal query measures their ability to make enquiries generally in other Internet-based platforms. This decision was made based on the research scope, which covered only a single MOOC and involved no other Internet-based learning platform. In addition, the findings of a preliminary study and the supporting literature further encouraged the researcher to reach the decision. The making-queries dimension measures students' capabilities to seek academic help and pose questions during their learning process in MOOCs (Fadzil et al., 2016; Nordin et al., 2015a). For the other two underlying dimensions, the researcher adapted the two dimensions of WLSE for the MOOC context, i.e. MOOC learning and MOOC usability. These two dimensions measure students' capabilities to learn in the MOOC setting and engage in MOOCs practically, and they are very important elements for MOOC success as mentioned by Almahdi and Sulfeeza (2017), Fadzil et al. (2015, 2016) and Nordin et al. (2015a, 2016). The underlying dimensions of the students' MOOC-efficacy in this research is presented as follows.

(i) Information Searching. Tsai and Tsai (2003) stated that students with a higher internet self-efficacy possessed better information searching strategies and learned better than their counterparts. Students with high self-efficacy in internet-based learning environments believe in their capabilities to search for information by using web-based learning features (Chen, 2014). For instance, in a MOOC environment, the online interaction features and information links given could be used to search for information (Ghazali et al., 2018). By using online interaction features, students would be able to discuss with other MOOC learners or instructors as one of the alternatives to obtain information in MOOCs. The inability to search for and access the relevant materials in MOOCs was found to be among the top five reasons for not completing a course in MOOCs (Goh, 2017). Students learn on their own in MOOCs and they need to know how to obtain the relevant information by using features available in it. There are many universities and other entities offering MOOCs but they do not adhere to one standard MOOC design or set of features (Greene et al., 2015; Toven-Lindsey et al., 2015) to search for information. Students have to know and

explore the available features in MOOCs to obtain information (Nordin et al., 2015a). Information searching dimension in the context of this research is defined as students' capabilities to search through the massive materials and volumes of input given by the MOOC instructor and other learners for relevant information, and extract the information using the various MOOC features provided (adapted from Chen, 2014; Goh, 2017; Nordin et al., 2015a; Padilla Rodriquez & Armellini, 2017).

(ii) Making Queries. Students' capabilities to make queries, seek academic help and clear up questions throughout their learning process are very important in an online learning environment (Chen, 2014) and for higher MOOC completion rates (Fadzil et al., 2016; Nordin et al., 2015a, 2016). The presence of support systems such as other MOOC students, instructors and administrators could help the students clear up questions on MOOCs (Nordin et al., 2015a; Rai & Chunrao, 2016). The feeling of isolation was revealed as one of the crucial factors for high dropout rates in MOOCs (Almahdi & Sulfeeza, 2017). This is in line with the research carried out by Nordin et al. (2015b), which revealed that more than half of the students (50.9%) perceived that they could not complete the tasks in MOOCs if there was no one to instruct them to act. A probable solution would be to integrate the concept of "mentors" in a MOOC learning environment as a form of support system. The mentors or the support system would be part of the MOOC community who would give students feedback when they face difficulties or require guidance and assistance especially in MOOCs (Nordin et al., 2015b). Constructive feedback could be useful for students who need assistance during their learning process. The context of making queries in this research is described as students' capabilities to make queries using the relevant MOOC features and support systems (adapted from Almahdi & Sulfeeza, 2017; Chen, 2014; Fadzil et al., 2016; Nordin et al., 2015a).

(iii) MOOC Learning. The term MOOC ('massive', 'open', 'online', 'course') represents the key factors that determine the characteristics of a MOOC learning. MOOCs allow a massive number of students to be enrolled and materials to be uploaded due to the concept of open-based online learning environment (Nordin et al., 2015a). The MOOC initiative has attracted a massive number of learners since its launch. MOOC learners are massive, diverse and from different backgrounds. A large number of students are gathered in a centralized hub to study a certain subject matter in MOOCs (Grover et al., 2013; Siemens, 2013). In addition, the MOOC platform has transformed the context of learning in which learners can learn outside the 'boundaries of learning institutions' (Nordin & Norman, 2018). MOOC learning dimension refers to students' capabilities to engage meaningfully with a massive number of learners and learning materials. This dimension also measured students' capabilities to learn in an open online learning environment (adapted

from Almahdi & Sulfeeza, 2017; Chen, 2014; Fadzil et al., 2015, 2016; Nordin et al., 2015a, 2016).

(iv) MOOC Usability. Student's ability to download, upload and engage with the learning materials in a web-based learning environment is referred to as web-based usability efficacy (Chen, 2014). Web-based usability efficacy discusses students' capabilities to engage with the learning features and materials in certain web-based learning platforms. In a MOOC environment, learning materials and learning tasks are essential elements for the learning process (Nordin et al., 2016). Through the open-based learning concept in MOOCs, students would require a higher level of management skills to use and understand the learning materials and complete the learning tasks. Students' capabilities to manage the learning materials and tasks in MOOCs show that the students are capable of using the MOOC platform effectively (Nordin et al., 2015b, 2016). Insufficient skills and limited ability to use MOOCs were revealed as crucial factors for high dropout rates in MOOCs (Almahdi & Sulfeeza, 2017). The MOOC usability dimension in this research is described as students' capabilities to use the learning features in a MOOC platform. In other words, this dimension measured the degree of students' capabilities to engage with the content and learning tasks in MOOCs (adapted from Almahdi & Sulfeeza, 2017; Chen, 2014; Fadzil et al., 2015, 2016; Nordin et al., 2015b, 2016).

MATERIALS AND METHODS

This research applied cross-sectional survey design. The data was collected through a structured survey questionnaire.

Survey Instrument

In developing the items of students' MOOC-efficacy, the following steps and procedures were adapted from The Standards for Educational and Psychological Testing (APA, AERA & NCME, 2014). Content validity ratio (CVR) is used for measuring the content validity of students' MOOC-efficacy factor in this research. The pilot study administered in this research is intended to check whether the items were clear in meaning to respondents and to establish the instrument's construct validity and reliability. The pilot study was administered to two hundred and eighty-nine (n = 289) students who volunteered to fill in the questionnaire. They all had an experience with MOOCs. Data from the pilot sample was analyzed to examine construct validity and reliability of the instrument. The data collected in the pilot study was subjected to an Exploratory Factor Analysis (EFA) and the findings of the analysis suggest that the 23 items loaded well into four dimensions to represent students' MOOC-efficacy and the measurement instrument achieved acceptable reliability ranging from 0.822 to 0.890. Table 1 indicates the dimensions and sample items for each underlying dimension of students' MOOC-efficacy.

Table 1
Dimensions and sample items for each underlying dimension of students' MOOC-efficacy

Underlying Dimension	Total no. of items	Sample Items	Sources
Information Searching	3	**When I need to search for information while using a MOOC, I am able to…** 1. use online interaction features to get information 2. use links attached to other relevant information websites 3. seek relevant information from the massive MOOC material	Chen (2014); Goh (2017); Nordin et al. (2015a); Padilla Rodriquez & Armellini (2017)
Making Queries	7	**When I face difficulties in a MOOC, I can…** 1. request help using 'HELP DESK' features 2. seek other learners/peers to share learning problems 3. seek advice from a MOOC instructor	Almahdi & Sulfeeza (2017); Chen (2014); Fadzil et al. (2016); Nordin et al. (2015a)
MOOC Learning	6	**I experience no difficulties…** 1. learning in a MOOC as an online learning environment 2. accessing learning materials in a MOOC at all time 3. exploring learning materials in a MOOC (without any limitation)	Almahdi & Sulfeeza (2017); Chen (2014); Fadzil et al. (2015, 2016); Nordin et al. (2015a, 2016)
MOOC Usability	7	**It is easy for me to…** 1. upload learning materials/assignments in a MOOC 2. engage in forum/comment/discussion in a MOOC 3. capture the basic concepts taught in a MOOC	Almahdi & Sulfeeza (2017); Chen (2014); Fadzil et al. (2015, 2016); Nordin et al. (2015b, 2016)

Data Collection Procedure

Data collection for the actual study was conducted in three public Universities in Malaysia (i.e. Universiti Putra Malaysia (UPM), Universiti Sains Islam Malaysia (USIM) and Universiti Teknologi Mara (UTM)). The study population was identified as university students who have had some experience with MOOCs and who willingly volunteered to participate in the research (N=1,524). The population was decided as such so that the study could have a clear sampling frame to make simple random sampling possible. The respondents were selected randomly from the sampling frame based on Krejcie and Morgan's (1970) guidelines for choosing a minimum sample size. Subsequently, using a random generation of numbers in SPSS, the researcher selected 50% of students in the sampling frame (n = 1,524 students) as respondents. In total, 762 copies of the questionnaire were distributed.

At the start of the data collection, the researcher gave a short briefing to explain the research, its purpose and how to respond to lecturers and students. Students were given 15 minutes to complete and return the questionnaire as soon as possible. The time was sufficient for them to respond on the spot, thereby minimising the risk of losing the questionnaire. From the 762 copies distributed, some 657 were returned, transforming a response rate of 86.22% to 100% was not possible for two reasons: (1) some students were absent from class on the day the survey was conducted, (2) others appeared to have dropped the course and could not be contacted. However, 34 questionnaires were not usable as they contained missing data. According to Sekaran and Bougie (2011), a 75% return rate is required for a research to fulfil its purpose and objectives. Thus, the return rate of 81.76% (n = 623) obtained in the study was more than desirable.

Data Analysis Procedure

The data collected was analyzed using Analysis of Moment Structures (AMOS). Confirmatory Factor Analysis (CFA) was conducted in order to empirically test the model of students' MOOCs-efficacy. Test of the validity and reliability of the instrument is in accordance to the standard procedure (Gan et al., 2012; Nasab et al., 2015; Sahranavard & Hassan, 2015).

RESULTS AND DISCUSSIONS

Confirmatory Factor Analysis

CFA was carried out to test the goodness of fit of variables measuring in the studies. Figure 1 shows the measurement model of students' MOOC-efficacy. The students' MOOC-efficacy measurement model includes four dimensions, namely information searching (IS), making queries (QU), MOOC learning (ML) and MOOC usability (MU). First, the degree of correspondence between the theoretical constructs and the observed data was assessed using goodness of fit (GOF) indices. The fit statistics, presented in Figure 1, indicate adequate fit between the measurement model and the data: RMSEA = 0.061, CFI = 0.935 and a normed chi-square (χ^2/df) = 3.322. According to Hair

et al. (2010), a hypothesized conceptual model that demonstrates a RMSEA value of < 0.08, a CFI value of ≥ 0.90 and a normed chi-square value of $2.0 \leq \chi^2/df \leq 5.0$ is accepted as having fulfilled the conditions of a valid measurement model. Thus, the indices of the MOOC-efficacy measurement model are within the acceptable parameters. Table 2 represents the fitness indices for the measurement model of students' MOOC-efficacy.

Convergent Validity and Reliability

The standardized factor loadings, composite reliability (CR) and average variance explained (AVE) values for the final measurement model of students' MOOC-efficacy are presented in Table 3. The z-score critical ratios are all outside the -1.96 and 1.96 range with p-values less than 0.001 for every measurement item indicating their statistical significance. According to Awang (2015), a factor loading of 0.6 and above for each item would indicate a high convergent validity. In this research, the factor loading of all the items are greater than 0.6 with a minimum value of 0.647. The AVEs of all four dimensions of the model (information searching, making queries, MOOC learning and MOOC usability) were greater than 0.5. Additionally, the CR value was greater than 0.7, therefore giving further evidence to support the convergent validity of the measurement model.

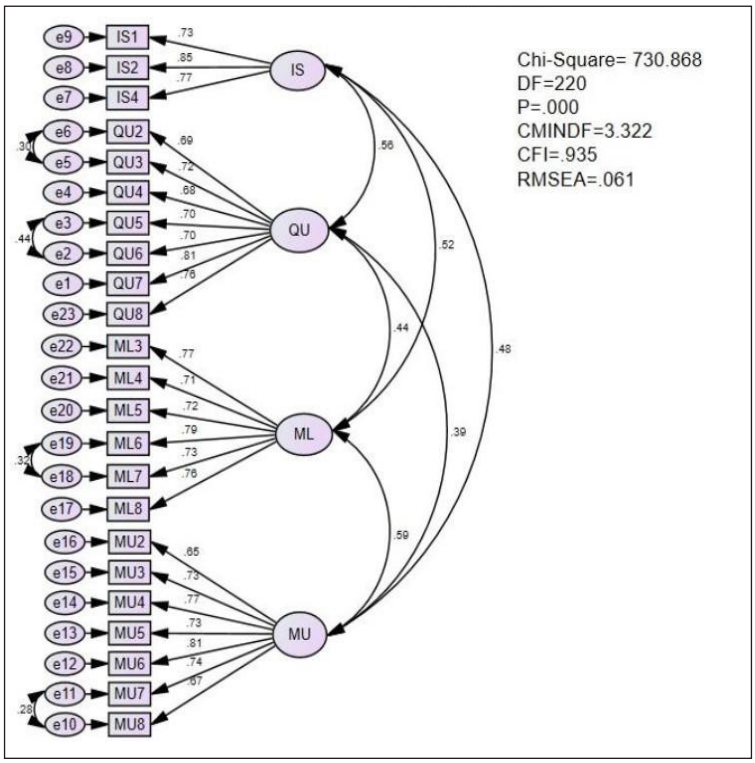

Figure 1. Measurement model of students' MOOC-efficacy

Table 2
Fitness indices for measurement model of Students' MOOC-efficacy

Parameter	No. of items remaining	RMSEA (<0.08)	CFI (>0.90)	Normed χ^2 (<5.0)	p-value (p > 0.001)
Students' MOOC-efficacy	23	0.061	0.935	3.322	0.000

Table 3
Standardized factor loading, CR and AVE for students' MOOC-efficacy

Dimensions	Items	Factor Loading	P	CR	AVE
Information searching (IS)	IS1	0.732	NA	0.827	0.615
	IS2	0.848	***		
	IS4	0.769	***		
Making Queries (QU)	QU2	0.694	NA	0.885	0.524
	QU3	0.718	***		
	QU4	0.676	***		
	QU5	0.704	***		
	QU6	0.703	***		
	QU7	0.806	***		
	QU8	0.757	***		
MOOC learning (ML)	ML3	0.770	NA	0.884	0.560
	ML4	0.709	***		
	ML5	0.722	***		
	ML6	0.787	***		
	ML7	0.733	***		
	ML8	0.764	***		
MOOC usability (MU)	MU2	0.647	NA	0.888	0.533
	MU3	0.732	***		
	MU4	0.767	***		
	MU5	0.728	***		
	MU6	0.813	***		
	MU7	0.742	***		
	MU8	0.669	***		

Note. IS means information searching; QU means making queries; ML means MOOC learning; MU means MOOC usability. :NA is for items with the weight fixed to 1,
*** denotes p-value <0.001.

Two assessments were used to establish the reliability of the measurement model, i.e. composite reliability (CR) and the AVE, and both assessments returned acceptable results. CR is an alternative measure to the Cronbach's alpha; it is recommended by Chin (1998) as an ideal measure to overcome some deficiencies in the Cronbach's alpha. The CR should be 0.60 or higher, while the minimum threshold for an AVE should be

0.5 or higher to indicate adequate reliability (Awang, 2015). The CR values for all four students' MOOC-efficacy factors were high, ranging between 0.827 (information searching) and 0.888 (MOOC usability). Their AVE indices also met the minimum threshold of 0.5, ranging between a low of 0.524 (making queries) and a high of 0.615 (information searching).

Discriminant Validity

The evidence for discriminant validity is summarized in Table 4. Each factor's AVE is presented diagonally in the table. The inter-factor correlations are located above the diagonal, while the squared inter-factor correlation coefficients (also known as shared variance, SV) are presented below the diagonal. The model's discriminant validity was evidenced by the AVE factors, which were higher than the squared shared variance (SV) for all the constructs (Fornell & Larcker, 1981). All the inter-factor correlation values in the model were below 0.85, thus also providing strong evidence for discriminant validity (Awang, 2015).

All the statistics provide empirical evidence that the measurement model of students' MOOC-efficacy is psychometrically sound in terms of validity and reliability. Researchers and psychometricians both agree that a valid and reliable measure in behavioural research is very important, as no valid conclusions about a phenomenon could be made without valid measurement (Creswell, 2012; Hair et al., 2010). Self-efficacy is multidimensional (Bandura, 2000; Chen, 2014; Ching et al., 2014) and tends to be domain-specific. Therefore, it is best assessed in terms of specific skills (Wang & Baker, 2015). The findings of this research show that students' MOOC-efficacy is a multidimensional construct consisting of four valid and reliable dimensions, namely (i) information searching, (ii) making queries, (iii) MOOC learning, and (iv) MOOC usability. The study also has provided evidence that students' MOOC-efficacy model exhibits convergent and discriminant validity as well as acceptable reliability.

The main theoretical implication or contribution of this research is the four-factor measurement model of students' MOOC-efficacy. This measurement model has enabled the researcher to measure four factors of students' self-efficacy in a MOOC platform, an area which is scarcely studied.

Table 4
Discriminant validity test outcomes

	IS	QU	ML	MU
IS	**0.615**	0.309	0.271	0.232
QU	0.556	**0.524**	0.193	0.151
ML	0.521	0.440	**0.560**	0.354
MU	0.482	0.388	0.595	**0.533**

Note. IS means information searching; QU means making queries; ML means MOOC learning; MU means MOOC usability.

The model may also help to identify which factors in students' MOOC-efficacy that contribute the most to low completion rates, or "lurkers", in MOOCs (Willis et al., 2013). Thus, efforts to increase the completion rates can be developed and implemented in light of teaching and learning theories, as well as to fulfill learners' preferences and needs (Pili & Admiraal, 2017). The findings from this research have generated some insights that help to address the gap in the understanding of the link between MOOCs and self-efficacy mentioned by Almahdi and Sulfeeza (2017) and Ghazali and Nordin (2016). In terms of practical implications, this research has produced a psychometrically sound instrument to measure students' MOOC-efficacy. The use of the validated MOOC-efficacy instrument may provide insightful information to students, instructors or lecturers, and higher learning institutions. Students can measure their level of MOOC-efficacy to make necessary improvements to increase their MOOC learning success. The scores may also assist lecturers or instructors in knowing their students' MOOC-efficacy levels in general and in specific dimensions. The findings will assist in designing professional development programs by higher learning institutions or any authorized organization**.**

On the other hand, this research is not free from limitations. The first limitation was the study's reliance on just one source of data--the self-reported students' MOOC-efficacy questionnaire. Thus, there is limitation in terms of getting a complete picture of the data. This is due to a number of reasons. First, respondents of a self-reported questionnaire may not be completely truthful in their responses, may lack the self-awareness to answer the questionnaire items correctly, or may not understand the importance of the study. Therefore, the data collected cannot be guaranteed as very accurate. Document analysis and other forms of quantitative or qualitative methods such as interviews and observations could have given richer data. Another limitation of this research is the response rate and data provided. The study's response rate was beyond the researcher's control. The data provided by the students represented their beliefs at the particular point in time when the survey was administered. Their beliefs may vary at different points in time. In addition, the researcher also had no control over factors that may have influenced students' responses such as their emotion and mental stability while answering the questionnaire, or may be students answered the questionnaire in a rush due to some personal matters need to attend to.

CONCLUSION

This research has contributed a new perspective to current literature on students' self-efficacy in the context of MOOCs and the measurement of students' MOOC-efficacy. It can be concluded that the proposed model supports students' MOOC-efficacy exploration in this research. It has produced an adequate measurement model and a psychometrically sound instrument of students' MOOC-efficacy. The final

dimensions of students' MOOC-efficacy are information searching; making queries, MOOC learning and MOOC usability. All the dimensions can be assessed by 23 items developed in this research. The information generated from the instrument can be utilized to determine the training needs of students, as well as those of lecturers and instructors. Furthermore, the COVID-19 pandemic wave has changed the educational landscape for higher education and increased the number of MOOCs' active users. As a result it is mandatory that MOOC providers or instructors develop quality courses, provide new user-friendly features and interactive material to attract and sustain students' interest, thereby increasing their motivation and efficacy in accessing MOOCs.

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