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Developing A Mobile Cartoon Structural Model to Enhance Critical Thinking Among Economics' Undergraduates

Khoo Yin Yin[1]* Noor Aini Ahmad, Ramlee Ismail

Abstract: *Economics students are facing problem to think critically and participate effectively in the collaborative learning context. Developing mobile cartoons that are related to students' daily life and address aspects of thinking can help improve students' critical thinking. The aim of this study is to develop a structural model for promoting economics students' critical thinking. This new model is based on Vygotsky's (1997) Zone of Proximal Development (ZPD) theory and Multimedia Learning Theory (Mayer, 2014). This study employed the quantitative research method. Phase one involved the developing of the model. In phase two, survey design was employed. A total of 293 economics students from two public universities were selected as samples. The findings from the Exploratory Factor Analysis retained six factors; which were conceptual understanding, analyse the problem, analytical, decision making, creativity and organize. Confirmatory Factor Analysis was employed and indicated good fit to the model. This study employed SEM to validate a structural model for Mobile Cartoons and this model can be used for future research. The findings from this study may assist lecturers and students to promote critical thinking. Future mobile cartoons research could focus on developing the application to enhance critical thinking with a larger sample.*

Keywords: *Confirmatory Factor Analysis, Critical Thinking, Mobile Cartoons, Economics,*

I. INTRODUCTION

Malaysia has been utilizing information and communication technology in education over the past decade. More than RM 6 billion has been spent to leverage ICT in education institutions, which is one of the main shifts in the Education Blueprint 2013-2025 (Ministry of Education, 2015). This report also stated that teachers and students in more than 10,000 schools in Malaysia are able to access the Internet to learn using the national and international learning resources. In other words, the advancement of ICT has provided more interactive learning resources for students to learn on their own in order to cultivate their higher order thinking skills.

Among all the ICT learning tools, mobile phone is the most popular gadget that is owned by the new generation (Mtega, Bernard, Msungu & Sanara, 2012; Kafyulilo, 2014). It is a known fact that mobile phone has grown rapidly as an important dimension of modern living. The number of smart mobile users has increased to 1.75 billion in 2014 globally (International Data Corporation, 2014). Smartphone users have increased 27% in Malaysia mobile market in 2014 alone (Lim, 2014). The growing importance of the smartphone has made educators to consider ways to utilize this device in formal teaching and learning activities. In addition, the rise of mobile devices has encouraged educators to

[1] Universiti Pendidikan Sultan Idris
Universiti Pendidikan Sultan Idris
Universiti Pendidikan Sultan Idris

consider ways of moving beyond the traditional face-to-face classroom and explore more customized technology-mediated learning environments.

A survey conducted in Malaysia reported that the majority of smartphone users were predominantly younger, aged between 20-24 years (Malaysian Communication Multimedia Commission, 2012). Thus, most undergraduates fall into this age group. In other words, undergraduates form the biggest proportion of the smartphone users. However, the most popular activity for smartphone users is texting messages (Switch, 2010; Lin, et.al, 2015). Since undergraduates are familiar with using smartphones in their daily life, a new dimension of pedagogy advancement about mobile learning can and should be developed or designed to benefit the students.

If most of the undergraduates are using the smartphone as a social media and gaming medium, an interesting and creative learning tool should be developed for learning. Among all the learning media, concept cartoons that are full of fun, interesting and related to students daily life can be a powerful pedagogical tool allowing both audio and visual communication (Chin & Teou, 2010; Ali Gunay, Didem & Erkan, 2016). Concept cartoons implemented on mobile devices offer significant opportunities for learning anywhere and anytime. Developing mobile cartoons that are related to students' daily life and address aspects of thinking can help improve student's decision making. Economics students are facing the problem to think critically and participate effectively in the collaborative learning context. A lot of undergraduates found that the economics course was the most difficult course among the art courses (Khoo, Khuan & Zainzam, 2016). A group of researchers found that economic graduates do not have deeper understanding of the economics concept and reasoning ability as compared to the normal graduates (Heijlities, Van Grog, Leppoink & Pass, 2014; Kuhn, Troitschanskaia, Brucker & Saas, 2018). Our Malaysian graduates also face the same problem where their thinking ability is only at the moderate level (Ministry of Education Malaysia, 2015). Cartoons are known to quickly attract students' attention, help them focus on key concepts and encourage discussion and argument among students (Zhang, 2012; Celik & Gundogdu, 2016). The use of cartoons allows lecturers to trace the development of students' understanding to avoid the occurrence of misconceptions. Therefore, there is a pressing need to develop a suitable learning tool to assist the economics students. It is interesting to know which variables have influence on the model. Using Structural Equation Modelling with Confirmatory Factor Analysis (CFA) can validate the questionnaire and examine the model fit. The aim of this study was to develop a structural model to enhance critical thinking among first-year economics students.

II. LITERATURE REVIEW

Theory

This study is based on Vygotsky's (1997) Zone of Proximal Development (ZPD) and Mayer's Multimedia Learning (2014). The ZPD is the difference between what a student can do without help and what he or she can do with the assistance of a facilitator. The ZPD is easier to achieve in collaborative learning (Vygotsky, 1997) that enhance higher order thinking (Saad, 2020) because group members can help the weaker student. Vygotsky (1997) said that concepts are the product of the students' thinking. Without proper understanding of concepts, the higher level thinking would not be achieved.

Mayer's Multimedia Learning Theory (2014) showed "people learn more deeply from words and pictures than from words alone". In other words, students can learn better with pictures. However, Mayer's theory also indicated a multimedia presentation of pictures can be interpreted better when related with the students' prior knowledge. For this study, students were exposed to new economics concepts in the mobile learning context. They had to resolve key ideas between their prior knowledge of old information and develop new understanding after watching the mobile cartoons. Students shared their ideas and helped peers to achieve a higher learning zone through the help of mobile cartoons. The lecturer and peers played an important role as the facilitator in assisting and explaining to students.

Researchers believe that the mobile device can serve as learning and teaching tool in exploring concepts (Yin, Song, Tabata, Ogata & Hwang, 2013). However, the device is seldom used. Mobile device can promote after class learning interest because it can enhance self-directed learning (Yin, Song, Tabata, Ogata & Hwang, 2013). Besides promoting students' communication skills, mobile phones can stimulate online discussion and reorganization of the ideas (Samuels, 2010). In line with these point of views, a mobile device has the potential to promote critical thinking. Therefore, mobile devices can expand learning and teaching activities through active learning (McConatha, Praul & Lynch, 2008).

Mobile learning

Mobile learning is part of e-learning. The difference between e-learning and mobile learning is mobile learning can take place anywhere and any place. Researchers believe that mobile learning embedded with collaborative learning can promote higher thinking order (Cheong, Bruno & Cheong, 2012). The findings of mobile learning in higher education is positive while enjoyment and performance are the crucial part of students' acceptance for the learning platform (Fagan, 2019). Hsia (2015) found that the usefulness of the mobile learning can influence the acceptance of the students too. Factors like learning expectancy, effort expectancy, social influence, facilitating conditions, mobile learning characteristics, and self-management of mobile learning are the main elements of students' acceptance. If the students have accepted mobile learning, then it is easier to embed collaborative learning that promotes higher order thinking.

Mobile learning in the smart classroom environment is able to provide students the platform for improving their collaborative skills which are direct reflection of higher order thinking (Wu, Xing & Lu, 2019). In this study, the researchers found that students' attitude towards the Internet will influence the higher thinking order. In other words, students who like the environment of mobile learning will outperform those who dislike online learning.

Mobile cartoons

Developing mobile cartoons was a new innovation in the mobile world. The findings from Turan (2014) concur that cartoons enhance students' performance. The results indicated that students showed interest in the usage of cartoons which contributed to the comprehension of the course content. The students also could understand the concepts in the cartoons. With the advancement of technology, concept cartoons can be combined with mobile learning and become mobile cartoons.

Mobile learning can provide a new platform of active learning, where students collaborate and participate among peers and lecturers. The app supported the mobile learning to share students' thought (Jahnke, & Liebscher, 2013).

With mobile devices, the students could participate in class actively, discuss with peers and indulge in self-directed learning. Teachers and students can communicate in the collaborative context actively and spontaneously (Kljunić & Vukovac, 2015). Mobile technologies enable students to share their ideas collaboratively (Ozdamli & Cavus, 2011). On the other hand, mobile devices can enhance collaboration between students and teachers to promote a dynamic learner-centered learning environment (Abidin, Mathrani, Parsons & Suriani, 2015).

Concept Cartoons enhance Critical Thinking

Researchers believed that concept cartoons can create critical thinking in science (Cruz & Cruz, 2018) and social science subjects. Concept cartoons can capture and engage learners, develop their critical thinking skills when students write their views (Cruz & Cruz, 2018). The same views have been supported by Demirci and Ozyurick (2017) and Yin and Fitzgerald (2017).

Demirci and Oyurick (2017) believed that the effectiveness of concept cartoons in learning gives an impact on critical thinking among students. Researchers also believed that the use of concept cartoons has a significant impact on problem solving (Siti Najihah, Nor Hasniza & Johari, 2018). Concept cartoons can enhance students' critical thinking skills, stimulate their ideas and improve their understanding (Naylor & Keogh, 2013). Previous researches also share the same views (Naylor & Keogh 2000; Naylor, Keogh & Downing 2007; Webb, Williams & Meiring, 2008; Chin & Teou, 2009).

Atasoya & Erginb (2017) pointed out that concept cartoons not only can challenge students' thinking but also evolve their conceptual understanding in Science subject. Moreover, Fradkin (2018) posited that concept cartoons can enhance better understanding in concept and promote critical thinking in Social Science subjects.

III. METHODOLOGY

This study is divided into two stages. The questionnaire was developed in stage one and the construct of the model was developed in stage two.

Stage one: Develop the questionnaire

First, the researchers read the literature reviews related to the mobile learning theory and critical thinking. The researchers analysed the conceptual framework, the questionnaire and the model.

Secondly, the researchers designed the model based on mobile learning content knowledge integrated in first year microeconomics course and instil elements of economics values such as decision making, and ability for problem solving to overcome obstacles in the mobile cartoons.

Stage two: Develop and examine the construct of the model

The researchers developed a mobile learning cartoons series related to students' real world experience with the content of mobile learning and elements of economics values in Malaysian-based context. This study employed survey design in the quantitative approach. The samples were selected using stratified random sampling. The random sampling was according to intact classes in order to avoid interrupting the current school system. This process involved examining and validating the model. Analysis of the model with reflective construct was conducted by using the Structural Equation Modelling.

Instrument

A 43-item questionnaire was developed as an instrument of the study. A pilot test was employed to 100 students in order to examine the reliability of the instrument before conducting the actual research. The content validity of questionnaire and other assessments was checked by a team of experts in economics education.

Samples

The questionnaire was administrated to 323 students. However, only 293 samples were used in this study after calculating the Mahalanobis distance. The outliers of the sample had been violated. Therefore, this study employed 293 students who were selected randomly from two public universities in Peninsular Malaysia. The samples were selected from undergraduate economics students because the development of mobile cartoons were based on the economics concept. A flow plan of the methodology is shown in Figure 1.

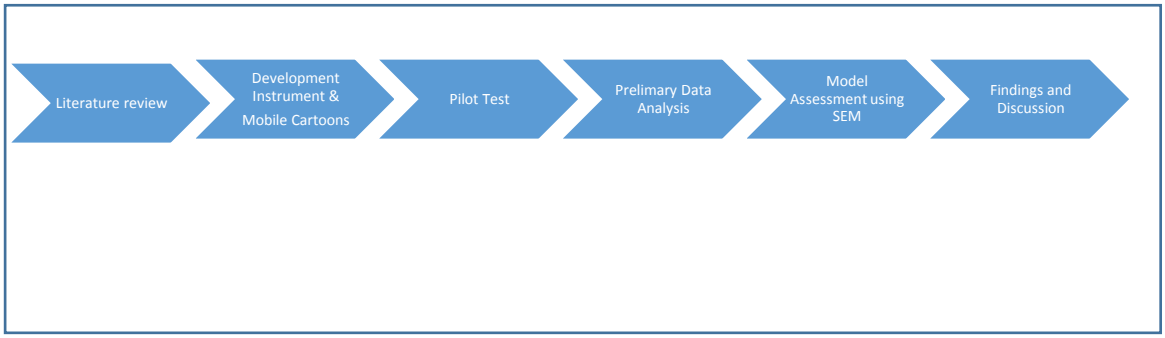

Figure 1: Flow Plan of Research Methodology

IV. FINDINGS

The assumption of normality, linear relationships between pairs of variables and the variables being correlated were checked before employing the principal axis factor analysis with varimax rotation. Based on the items in the questionnaire, six factors were requested to index six constructs: conceptual understanding, analyse the problem, analytical, decision making, creativity and organize. Convergent validity was measured through factor loadings for reflective measurement model. The result of the existence of six factors explaining those factors with loadings more than .5 were selected into the model of CFA. For those factors with loadings less than .5, extraction has been done. After the extraction and internal validity tested, only 27 items remained. Table 1 shows the analysis of principle axis factor analysis.

Table 1: The Principle Axis Analysis Factor Analysis

Item	Factor Loading						Communalities
		2	3	4	5	6	
p1	.745						.648
p2	.645						.511
p4	.735						.617
p5	.771						.698
p6	.753						.617
p13	.551						.418
p14	.572						.395
p7		.516					.522
p9		.597					.532
p10		.578					.523
p5		.644					.579
p6		.689					.484
p21			.599				.431
p22			.721				.656
p23			.758				.757
p24			.693				.679
				.605			.601

p25				
p26		.708		.663
p27		.723		.721
p28		.599		.507
p32			.797	.688
p33			.816	.647
p37			.747	.613
p38			.703	.560
p40		.761		.661
p41		.789		.736
p42		.829		.750

Referring to Table 1, the first factor seemed to index conceptual understanding, had strong loadings on item 1, 4, 5 and 6. The second factor, which seemed to index analyse the problem had moderate loadings on 5 items. Index of analytical had high loadings on item 22 and 23. The fourth factor, which seemed to index decision making only had high loading on item 26 and 27; whereas moderate loadings on item 26 and 28. Fifth and six factors that index of creativity and organize had high loading for all the items. Item 42 had its highest loading from the creativity.

A total of 55.549 % of the total variance have been explained by the six factors. First factor conceptual understanding had explained 31.743% of the variance, second factor, analyse the problem explained 6.985%, third factor, analytical explained 5.396, fourth factor, decision making explained 4.189, creativity was the fifth factor explained 3.737 and the sixth factor, organize only explained 3.499.

On the other hand, the reliability of the scale and the internal consistency of the questionnaire were examined by coefficients of Cronbach Alpha. This finding were presented in Table 2. According to Sekaran and Bougie (2010), the result was only reliable as it exceeds 0.70. Two negative items were deleted due to low value of Cronbach Alpha.

Table 2: Cronbach Alpha Value

Subscale	Items	Item deleted	Cronbach Alpha
conceptual understanding	7	-	.869
analyse the problem	5	-	.821
analytical	4	-	.858

decision making	4	-	.835
creativity	4	1	.850
organize	5	1	.719
Total	29	27	

Based on the findings of principal axis factor analysis with varimax rotation, the research model was built. Figure 2 shows the six factors research model and describes the components of the questionnaire on critical thinking (conceptual understanding, analyse the problem, analytical, decision making, creativity and organize). These paths were related to causal processes. Thus, Confirmatory Factor Analysis (CFA) procedures were used to examine these six components (Kline, 2010).

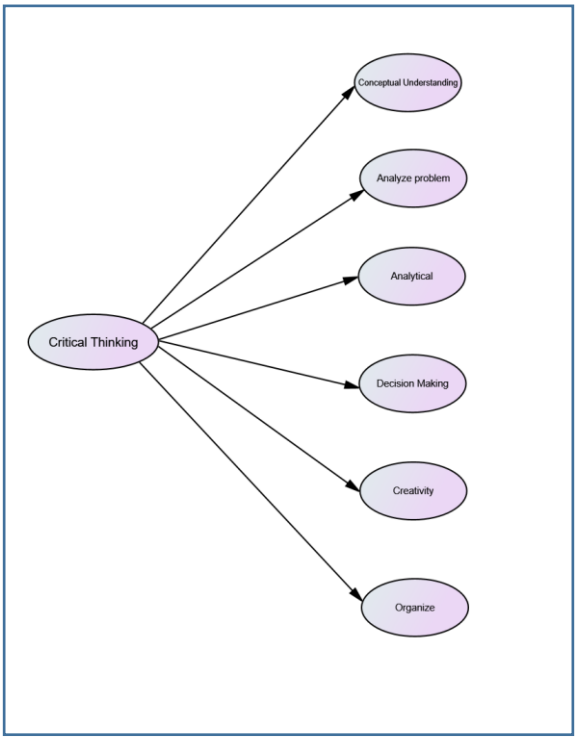

Figure 2: Research Model

The model has been evaluated using the Confirmatory Factor Analysis (CFA). The selected analysis method (CFA) was employed to check the factor scale within a measurement model. It was also used to determine the goodness of fit of a model (Bollen, 1989). Researchers believed that CFA in Structural Equation Modelling can develop the most parsimonious model that is valid and has high goodness of fit (Hair et al., 2006; Hair, Hult, Ringle, & Surstedt, 2017). Two types of measurement models were employed in this study: 1) First order measurement model, and 2) Second order measurement model.

The six factors model that was built from the principal axis factor analysis with varimax rotation was examined. The model was modified based on the analysis of residual values, modification test and variation of parameter estimates. With reference to Figure 3, the model met the criteria of the goodness of fit in the model with the chi square (CMIN/df= 1.648), the value of CFI=.950, TLI=.942 and GFI=.902. All the CFI, TLI and GFI are higher than .90. The indicators exceeded the threshold value of .90, showing acceptability to good indexes of fit. RMSEA =.047 was considered good index of fix, the indicator that smaller than 2.0 is considered very good index and value between 2.0 and 5.0 is acceptable (Hair et al., 2006).

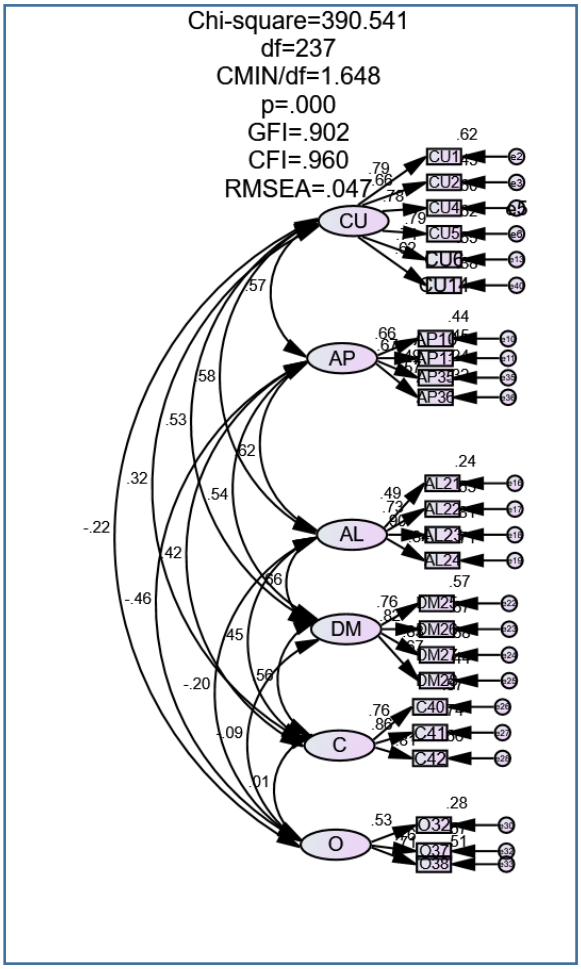

Figure 3: First order Measurement Model

After conducting the first order CFA with a good indexes of fit measurement model for the mobile cartoon construct, a further examination was carried out to examine this model at the second order CFA. Figure 4 presents a good indexes of fit second order model of mobile cartoon. The CMIN/df=1.762 met the required threshold value of < 5 indicated high good index of fit. The CFI=.939 and TLI =.931, all the indicators exceeded the guidelines of greater than .90, indicating good indexes of fit. The RMSEA also showed an excellent value of .051.

A further investigation of second-order models in this study since the questionnaire had a few sub- constructs and each construct measured by multiple items. In comparison, first-order models correlated factors, second-order factor models can provide a more parsimonious and interpretable model when researchers hypothesize that higher order factors underlie their data. The second order measurement model of mobile cartoon was validated and demonstrated a good factorial validity, suggesting that the core of the mobile cartoon model could be best represented by six factors as mentioned above. These include conceptual understanding, analyse the problem, analytical, decision making, creativity and organize.

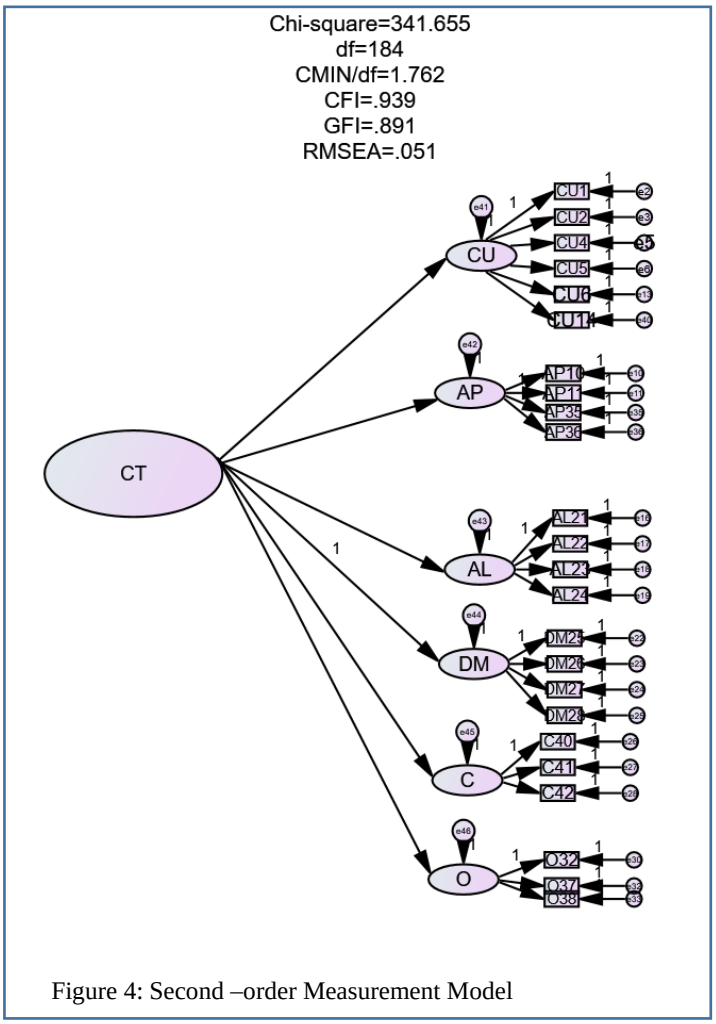

Figure 4: Second –order Measurement Model

V. DISCUSSION

In testing of the Mobile Cartoon Measurement Model, the findings are in line with the literature review that showed mobile cartoons enhance conceptual understanding, analyse the problem, analytical, decision making and organize (Wu, Xing & Lu, 2019). Students must understand the concepts before applying in the problem. They must have analytical skills in order to enhance critical thinking. They need to organize the facts and make decision of which factors need to remain in the argument. However, a new element found in the model is that mobile cartoons can enhance students' creativity as well. Students can create something different after watching the mobile cartoons. They also have the idea to produce from the mobile cartoons.

In the context of education, economics learning should be implemented in a way that promotes higher thinking order like critical thinking. The findings of this study will redound to the benefit of economics students, educators, society and the nation considering the need of the economics knowledge in the society.

Educators also agree that learning economics also has become very important because it relates to an individual's well-being. The impact is linked closely to society because students will become good decision makers.

The significance of the study includes the contribution to develop a proper learning model that is tailored to Malaysian universities which is in line with the Malaysian Education Blueprint. On the other hand, the integration of the digital learning tool not only can make the lessons more meaningful for example, mobile cartoons but also promote

learning (Yeop, Yaakub, Wong, Don, & Zon, 2019; Wong, Abdullah &Abas, 2019) . Mobile learning is tuned to the reality that technology and the networked era were threatening to stretch the already-wide equity gap in education unless there is decisive intervention and a strong public agenda. In conclusion, the development of the model for mobile cartoons was successful and improved students' critical thinking. The limitation of this study is the sample only involved students from two universities. Future mobile learning research could focus on developing the application to enhance the critical thinking with a larger sample.

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