



Determining the Influence of Cultural Values on Promotion of Higher Order Thinking Skills in Technology Enhanced Learning Environment

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Abstract

Higher order thinking skills (HOTS) is a way of thinking that moves beyond memorization of facts to higher level thinking such as synthesis, analysis and evaluation. Mastering HOTS is important for students to excel in their education and real-life. Many factors are believed to promote HOTS among students. One such endeavour is integrating Information and Communication Tools (ICT) in teaching and learning activities. ICT is believed to enhance students' performance and higher-level thinking. It is understood that culture plays an important role in determining an individual's decision to adopt ICT to promote HOTS. The influence of cultural factor is more crucial to students from multinational countries such as Malaysia. Thus, this study aimed to investigate the influence of students' perceived culture (collectivism and uncertainty avoidance) and attitudes towards technology use on the promotion of HOTS in ICT integrated mathematics classes in higher education contexts. A total of 250 mathematics students from 3 local public universities in Malaysia participated in this study. Structural equation modelling revealed that students HOTS is significantly influence by attitudes towards technology use. Uncertainty avoidance strongly influence attitude towards technology use. However, collectivism is not a strong predictor of attitude towards technology use. The practical implications of the study are discussed.

Keywords: higher order thinking; uncertainty avoidance; attitude towards technology use; technology enhanced learning environment.

1 Introduction

Higher order thinking (HOT) and Information and Communication Technology (ICT) are the two most important elements grounded in today's globalized and sophisticated educational system. Higher order thinking ability is highly encouraged by educators for their students to challenge them to achieve critical values, the sense of creativity and find new ways of solving challenges as well as making adequate decisions [17]. Students with higher order thinking skills (HOTS) are expected to experience excellence academic performance and apply the cognitive knowledge in real-life situation to obtain better quality of life [3, 27]. Simultaneously, the integration of ICT in classroom provides innovative ways of support to educators, students and the learning process [18]. The use of ICT is believed to promote HOTS of students effectively. For instance, use of digital game-based learning could help students to develop creative thinking, critical thinking, problem solving skills and obtain better academic achievement [68, 60]. Integration of ICT in teaching process also fosters sharing, interactivity and collaboration among students that can lead to promotion of HOTS [59]. Similarly, [16], highlighted that blending critical thinking process in online-based activity invoke students' interest towards learning and create platform to reach a higher level of knowing. Multicultural nation such as Malaysia also shows difference in critical thinking ability where different ethnic group (Malay, Chinese and Indians) exhibited different level of capability when comes to critical thinking development through blog writing. For instance, [55] reported that Malay students outperformed other ethnic groups to post writing that consists of critical thinking abilities as compared with their counterparts.

It is understood that culture plays an important role in determining an individual's decision to adopt ICT that can leads to promotion of HOTS. Culture can loosely be understood as the ideas, practices, goals, characteristics, inferences and pattern of thinking that are shared by members of a society to coordinate their behaviour [21, 23]. Culture also guides a society about the importance of rules, rituals and procedures [38]. Past studies indicated that cultural factors significantly influence promotion of HOTS in ICT integrated classes [16, 55]. Besides, cultural factor also found to influence student mathematics performance [25, 43]. For instance, in Malaysia, Chinese students outperformed in mathematics compared with Malay and Indian students [56]. Similarly, non-Malay students also found to be performed significantly better in mathematics than Malay students [36]. Nevertheless, very limited studies were conducted to understand the link between the cultural factor and mathematics achievement including promotion of HOTS in ICT integrated classes in multinational countries like Malaysia. Thus, it is important to investigate the relationship between culture and promotion of HOTS in ICT integrated mathematics classes, which is underrepresented in the literature [55, 32]. This is especially true in multicultural societies such as Malaysia [55] where the promotion of HOTS in ICT integrated classes should focus on the entire ethnic group in Malaysia [42]. Furthermore, the scenario in Malaysian higher learning institution also shows that students' achievement in mathematics questions related to HOTS is still not at the satisfactory level. The students are lacking in mathematical problem-solving skills, analysis, reasoning, evaluating and creating (Sharifah, K. personal communication, March 4, 2019). Thus, there is a need to investigate the influence of cultural factor towards this scenario. This will contribute to enhancing readers understanding on what are the cultural values that contribute significantly to promoting HOTS in ICT integrated mathematics classes in higher education contexts.

1.1 Cultural diversity in Malaysia

Malaysia is a multicultural nation. Malaysians consists of different ethnic groups such as Malays, Indians, Chinese, Kadazandusun and Iban. The Malay culture emphasizes values on courtesy, moderation, tolerance, harmony and cordial relations among community members [29]. Relationships among the Malays are largely hierarchical and collective. Like the Malays, the Chinese are cohesive, collective and very often allowed the elders to make important decisions for them [57]. In addition to this, Chinese are driven by financial rewards [54]. They value hard work or diligent, sensible thinking, prosperity, face, peace and risk taking. The Indians value the extended family with hierarchically structured. The Indians are known for their trustworthiness, hard work, democratic and organization abilities. Indians also value face, fear of God, fellow feeling and filial piety [52]. Each ethnic group in Malaysia retains its own identity. However, certain cultural values seem to be shared by all ethnic groups. For instance, [1] highlighted that Malaysians are known for a compromising, conflict avoidance and collaborative attitude. They place high values for religion, hierarchy and are concerned about face. Hofstede's cultural dimensions also has reported similar findings about Malaysia's culture. Malaysians recorded 100 for power distance, 26 for individualism, 50 for masculinity and 36 for uncertainty avoidance. It shows that Malaysians place high values for hierarchical structure, collaborative attitude and low preference for avoiding uncertainty (leads to more relaxed attitude).

1.2 ICT integrated learning environment

Instructional interventions such as learning materials, learning task and teaching strategies that make students to think creatively, critically and logically could enhance students' HOTS. ICT as of the intervention is also believed to has the ability to promote HOTS among students. ICT integrated learning environment refer to use of ICT in diverse learning context, location and culture of students [10]. ICT integrated classes is believed to enhance learning experience by challenging students' abilities and triggering their motivation. ICT integrated classes also make learning environment more enjoyable by providing active learning platforms in and out of classroom that can lead to promotion of HOTS [28, 66]. Past studies have shown that ICT affordance enhances students' HOTS by encouraging development of ideas, making connection, establishing collaborations to generate, evaluate and refine ideas, promote reflection and extend learners view to provide creative outcomes with multiple perspectives [39, 32]. Thus, researchers strived to identify how to design and implement ICT in learning environment so that it can enhance HOTS among students effectively [32].

Use of ICT tools in mathematics classroom influence students' academic outcome and the way of thinking [45]. ICT is also believed to increase students' motivation and engagement level towards mathematics [69]. ICT integrated mathematics flipped classroom provides students opportunities to develop the ability to think high level and work independently inside and outside of the classroom. Further, tools such as GeoGebra assisted the students in reasoning the relevant mathematics concept efficiently [69]. ICT is also assisted students to learn the mathematics concepts in depth by providing individualisation of learning coupled with increasing interest [65]. In addition, ICT facilitates students' problem complex solving skills in mathematics that can lead to promotion of HOTS [65]. Thus, integration of ICT in mathematics classroom provides a promising platform to enhance HOTS among students.

1.3 Attitude towards technology

Attitude towards technology proposed as a key variable that directly affects individual's behaviour intention to use technology that can lead to the actual use of technology in technology acceptance model (TAM) [12]. Past study showed that there is a strong link between students' attitudes towards the use of technology for learning mathematics and their achievements [9, 34]. The characteristics of the ICT that are relevant to mathematics, aid students in learning mathematics by the provision of many examples. This shape the attitude of the students towards the use of ICT in mathematics classrooms [7, 50]. Besides, behavioural and affective commitment to mathematics, confidence in mathematics and technology are also strongly influence students' attitude towards technology in mathematics classroom that can determine students' performance in mathematics [44].

In TAM attitude towards technology is directly explained by perceived ease of use and perceived usefulness. Although TAM is well recognized as the valid model to explain individual's technology acceptance, but researchers often criticise its inability to consider the influence of external variables specially culture when examining individual's technology acceptance given culture can influence people's thinking and behaviour [64]. Furthermore, culture has been determined in the literature to have a major influence on technology acceptance [5]. Often studies related to culture in non-western nations take the existing knowledge related to culture and technology acceptance in developed western nations and relate it to non-western nation. However, it is important to highlight that technology users around the globe have different style of thinking, cultural values and assumptions [71]. In order to answer the relationship of culture to technology acceptance, researchers extended the TAM by including variables such as social-norm and computer self-efficacy [26]. [63] use cultural factor as moderator to examine individual's acceptance towards technology. It is important to highlight that, past studies that examine influence of cultural values on attitude and acceptance towards technology, rarely examine the direct relationship of cultural values towards technology acceptance particularly in mathematics classroom, thus it is crucial to examine the direct relationship of culture on attitude towards technology in mathematics classroom. This will address the research gap in literature and provide people with further understanding on how cultural values directly influence different user's attitude towards technology in mathematics classroom. It is important to highlight that, past study has investigated the influence of cultural values on mathematics achievement in traditional mathematics classrooms [43]. However, very limited research has investigated the achievement of students in mathematics in ICT integrated classrooms and its relationship with attitude towards technology. This will answer the disparity existed in the mathematics achievement among students who have different cultural values particularly in the ICT integrated classroom as highlighted by [58].

1.4 Higher order thinking skills

Higher order thinking skills include critical thinking, problem solving, decision making and creative thinking [27, 35]. HOTS widely recognized as a way of thinking that moves beyond memorization, recall and understanding of facts to synthesis, analysis, evaluation and creation of knowledge [8, 37]. [30] argued that HOTS will be evoked when an individual confront ambiguities, uncertainties and unfamiliar problems. When HOTS well developed, an individual can make good judgement and provide appropriate solutions to the problems. According to [33], HOTS involve complicated cognitive skills that required students to i) apply information, ideas or methods in new situations, ii) forecast outcomes, solve problems with selected new approach, iii) segregate problem into parts, iv) recognise the critical component of new problem, v) observe

the pattern and organisation of parts, vi) evaluate the quality of diverse pieces of information, vii) categorise the ideas, viii) make judgement to the different pieces of evidence to determine the quality and prospect of certain outcomes and ix) select the output based on reasoned argument. By applying the HOTS, students can achieve "clarity, relevance, consistency, logic, depth, completeness and significance in their thinking" [32].

Attitude towards technology use is predicted to be important criteria that can determine promotion of HOTS among students in ICT integrated classes. [32] argued that students' attitude towards technology use engage students in active learning where students can explore, plan and create new things and practice skills in different context. Attitude towards technology use may affect students thinking either affectively or cognitively. Affectively they might find the technology is enjoyable and attractive. Cognitively, they might experience other academic benefits such as excellence academic performance and great peer and expert interaction [32]. Attitude towards technology use is believed to influence students' engagement towards learning which can lead to promotion of higher cognitive skills in ICT integrated classes. Positive attitudes indicate that once students are successful using ICT and realise the associated benefits, they will continue using the ICT tools as a learning tool to increase their performance. [32] asserted that students' negative attitude towards technology use can affect their technology use and consequently affect their engagement towards learning. [67] pointed out that there is lack of research that directly investigating the effect of attitude towards technology towards promotion of HOTS. Thus, it is worth investigating the influence of attitude towards technology towards promotion of higher order thinking skills in ICT integrated classes.

1.5 Higher order thinking skills in mathematics

Researchers argued that students' mathematics achievement is prominent to gain economic power and competitiveness of a nation [61]. Thus, The Malaysian Ministry of Education had emphasized for the integration of HOTS in mathematics to enhance students' performance. HOTS are important to help students solve mathematics problems that cognitively challenging. Mastering HOTS assist the students to answer mathematics problems that demand higher level thinking such as evaluation, application, analysis and creating. Many studies have discussed about the ways to improve students HOTS in conventional mathematics teaching and learning setting [61, 40]. In conventional mathematics classroom, teaching methods, teachers' quality and learning contents are considered important factor that could enhance HOTS. However, studies that focus on developing HOTS among students from specific discipline such as mathematics in TEL environment still lacking [32]. Thus, it is important to identify the role of culture as suggested by [32] in mathematics TEL classroom.

1.6 Culture

Researchers has highlighted that culture plays important role in determining user acceptance of ICT to enhance their performance [47, 48]. [70] highlighted that culture plays important role in determining user acceptance of e-learning to achieve academic benefits. [21] cultural dimensions are considered the suitable dimension to evaluate individuals' perceived cultural values towards attitude towards technology as it is widely used in many empirical studies including in educational context [62, 64]. [21] identified four dimensions of cultural values, namely, individualism-collectivism, power distance, uncertainty avoidance and masculinity-femininity. Culture plays an important role in determining adoption of new ICT tools in an organisation to enhance their per-

formance [41]. It is important to highlight that both individualism-collectivism and uncertainty avoidance dimensions have been found to be more influential in ICT adoption studies than the other two cultural dimensions [14]. Similarly, [53] reported that, individualism-collectivism is the dimension most frequently used by researchers to understand the differences between two or more given cultures in educational context. Students and educators from an individualistic culture are believed to use the ICT tools because of its effectiveness in enhancing performance but not because of the social pressure as described in collectivism culture [53]. Meanwhile, when an innovation is introduced in educational environment, students will exhibit different attitude towards uncertain matters, where in the current scenario the students most probably hesitate to use the ICT tools in their academic work as they uncertain about its outcome [53].

Besides culture is also found to be an important element that determined students’ mathematics achievement [43]. For instance, individualism-collectivism and power distance dimensions strongly influence students’ mathematics performance in Asian countries such as China [25]. Meanwhile, US students who have individualistic culture is showed better mathematics self-efficacy as compared with students from high in collectivism culture [4]. Considering the influence of cultural values towards the adoption of ICT tools and mathematics achievement, the current study links two main cultural dimensions of Hofstede measures; collectivism and uncertainty avoidance, on attitude towards technology use to promote HOTS among mathematics students.

According to [13], collectivism is one of the critical factors that affects individuals’ attitude towards technology. In collectivist culture where the people give priorities to societies that they belong to. Collectivist culture that shows preference for a tightly knit framework in society. In collectivism an individual’s attitude towards the technology is shaped by the member of the society.

"The Uncertainty Avoidance dimension expresses the degree to which the members of a society feel uncomfortable with uncertainty and ambiguity" [20]. A high uncertainty avoidance among individuals increases the anxiety level among them and allow the acceptance of the innovation. In the context of this paper, high uncertainty avoidance, could create negative attitude towards technology that could affect promotion of HOTS among students. In educational setting, researchers have reported that uncertainty avoidance plays important role in students’ adoption of technology beyond the classroom [31].

The objective of the study is to investigate the influence of students’ perceived cultural values (collectivism and uncertainty avoidance) on the promotion of HOTS in ICT integrated mathematics classes in higher education contexts. The research model is shown in Figure 1.

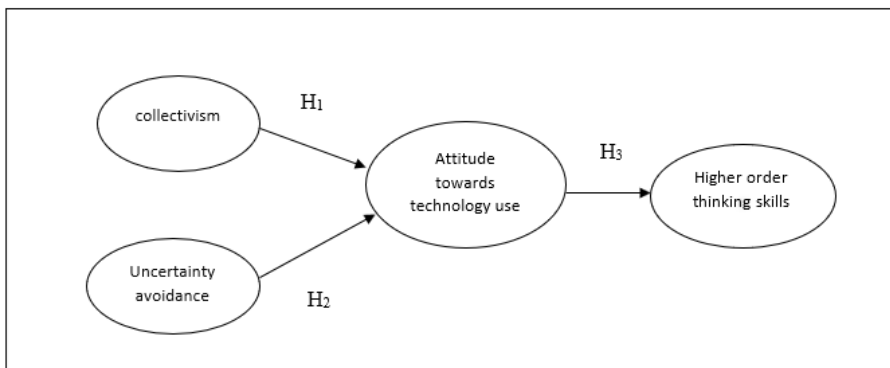


Figure 1: Research model with hypothesis.

- H_1 : Perceived collectivism has a direct impact on student’s attitude towards technology use.
- H_2 : Perceived uncertainty avoidance has a direct impact on student’s attitude towards technology use.
- H_3 : Attitudes toward technology use has a direct impact on student’s higher-order thinking skills.

2 Methods

2.1 Research design

The study applied descriptive research design. The current study used descriptive research design because the research aimed to understand the influence of cultural values to the promotion of HOTS in ICT integrated. This study used quantitative approach to collect data from the target respondents. Quantitative approach was used in order to determine the magnitude of influence of cultural values towards attitude towards technology that led to the promotion of HOTS

2.2 Participants

The participants in the study included university students from the department of mathematics. University students were recruited from three different universities in Malaysia. These three public universities were chosen because they were research universities in Malaysia and actively integrate ICT in teaching and learning activities. There was a total of 250 students who participated in the study. These university students come from both bachelor and master’s degrees. The students from these three universities were from different ethnic groups in Malaysia. Thus, it is appropriate to test whether the relationships between the cultural dimensions and attitude towards technology use vary in multinational country such as Malaysia. The mean age of the respondents is 23.5 with standard deviation of 6.30. 18% of the respondents were males and 82% were females. Out of 250 students, 82.4% of the respondents were Bumiputra (mainly Islam), 8% were Chinese, 3.6% were Indians and 6% from other races. 68.4% students from bachelor degree and 31.6% from master degree. Table 1 shows the demographic distribution of the participants.

Table 1: Demographic details of the participants.

Demographics details	Category	Frequency	Percentage (%)
Gender	Male	45	18
	Female	205	82
Ethnic	Malay	206	82.4
	Chinese	20	8
	Indian	9	3.6
	Others	15	6
Programme	Bachelor	171	68.4
	Master	79	31.6

2.3 Procedure

Data for the study were collected using the convenient sampling technique by means of an online survey. The students received emails that included links to a questionnaire on Google Form. The data were collected via snowballing procedure. The researchers received consent from the respondents to participate in the survey. The respondents were explained about their rights to withdraw from the study at any time for any reason. A total of 258 students answered the online questionnaire. After 8 invalid responses were eliminated, 250 valid samples were collected.

2.4 Instrument

The survey instruments consisted of two parts. The first part collected the participants’ demographic information, such as gender, age, ethnic group, level of education and the technologies they use in their learning process. The second part consisted of a set of items (measured by 5-point Likert Scale, 1 = strongly disagree, 5 = strongly agree) representing the constructs of interest, namely, cultural dimensions of Collectivism (4 items) (adapted from [22]), Uncertainty avoidance (4 items) (adapted from [22]), attitude towards technology use (9 items) (adapted from [12]) and higher order thinking skills (4 items) (adapted from [32]). The instrument was developed by adapting questions from past established questionnaire developed by [22], [12] and [32]. The adapted questionnaire was validated by two experts in the field of ICT in education.

3 Results

3.0.1 Descriptive statistics

SPSS 28.0 was used to compute the descriptive statistics and univariate normality. The mean value for collectivism, uncertainty avoidance, attitude towards technology use and higher order thinking skills were 3.46 (SD = 0.74), 3.83 (SD = 0.55), 4.23 (SD = 0.61) and 3.08 (SD = 0.57) respectively. The skewness value ranges from - 0.424 to - 0.161 and kurtosis value ranges from - 0.223 to 0.601. The results indicated that samples achieved normal distributions suggested by Kline (2010) (skewness does not exceed| 3 |and kurtosis does not exceed| 8 |). The figures are shown in Table 2.

Table 2: Descriptive results.

Construct	Col	UA	ATT	HOTS
Mean	3.46	3.83	4.23	3.08
Skewness	-0.16	-0.26	-0.42	-0.21
Kurtosis	-0.22	0.5	0.54	0.60

Col: collectivism, UA: uncertainty avoidance, ATT: attitude towards technology use, HOTS: higher order thinking skills

3.1 Test of the measurement model

The CFA results are shown in Table 3. The standardised factor loadings for all items were greater than 0.50, between 0.57 to 0.89 within the acceptable range of 0.4 suggested by [15]. All Cronbach’s alphas were more than 0.70 indicating good reliability of item within a construct [11]. Convergent validity of the measurement model was measured based on composite reliability (CR) and average variance extracted (AVE). All the CR values of the constructs were greater than 0.70 indicating good internal consistency [46]. AVE of the all the constructs were greater than 0.5 (except for uncertainty avoidance = 0.43), within the acceptable range suggested by [46]. According to [19], AVE value greater than 0.4 is acceptable as long is the CR (CR for uncertainty avoidance is 0.75) is greater than 0.6.

Table 3: Results of measurement model.

Construct and item	Standardised factor loading (> 0.50) ^a	Cronbach’s alpha (> 0.70) ^a	Composite reliability (> 0.70) ^a	Average variance extracted (> 0.50) ^a
Collectivism (Col)		0.89	0.90	0.70
Col1	0.87			
Col2	0.85			
Col3	0.89			
Col4	0.71			
Uncertainty avoidance (UA)		0.85	0.75	0.43
UA1	0.72			
UA2	0.69			
UA3	0.57			
UA4	0.63			
Attitude towards Technology Use (ATT)		0.91	0.91	0.53
ATT1	0.61			
ATT2	0.69			
ATT3	0.67			
ATT4	0.70			
ATT5	0.81			
ATT6	0.67			
ATT7	0.76			
ATT8	0.83			
ATT9	0.78			
Higher order thinking skills (HOTS)		0.93		
HOTS 1	0.82		0.90	0.68
HOTS 2	0.85			
HOTS 3	0.80			
HOTS 4	0.84			

^a indicates an acceptable level of reliability or validity

The comparative fit index (CFI) and Tucker-Lewis index (TLI) were used to analyse the fit of the measurement model, with values greater than 0.90 indicating an acceptable fit. The root mean square error of approximation (RMSEA) and standardised root mean square residual (SRMR) were also calculated where values less than 0.08 indicating acceptable results [19]. The model fit indices for the measurement models indicated they had acceptable fit to the data. The model fit indices were CFI = 0.924, TLI = 0.912, RMSEA = 0.078, SRMR = 0.090. According to [24], SRMR value from 0.05 and 0.09 is still acceptable. The indices for the measurement model showed that they have acceptable fit to the data.

3.2 Test of the structural models

The structural equation model as a whole accounted for 31.4% of the variance in HOTS. Collectivism was not a strong predictor of attitude towards technology, contrary to our expectations. Thus, H_1 is not supported. H_2 was fully supported indicating a direct significant impact to UA and ATT ($\beta = 0.63, p < .001$). While ATT was also significantly and directly linked to HOTS ($\beta = 0.56, p < .001$), which indicates that H_3 was supported.

4 Discussion

This study aimed to investigate the effects of cultural factors (collectivism and uncertainty avoidance) and attitude towards technology use on promotion of higher-order thinking skills in mathematics TEL environment. The results indicated that learners' higher-order thinking skills was directly affected by attitude towards technology use. Higher order thinking skills also indirectly affected by uncertainty avoidance factor through attitudes towards technology. Meanwhile, contrary to our expectation, collectivism does not affect attitude towards technology use.

The result shows that the first hypothesis of the study indicating collectivism has a direct impact on mathematics student's attitude towards technology use is not supported. This implies that influence from society or important figures such as family members did not affect the respondents' attitudes towards technology use. The finding is consistent with the finding of [49] who reported that the individual attitude had a stronger impact on attitude towards technology use than social attitude in Korea. Furthermore, the finding also confirms the findings of [6] who indicated that collectivism do not have significance impact on perceived ease of use and perceived usefulness of technology adoption among people in developing countries. Meanwhile, [41] also reported that collectivism has negative relationship with perceived ease of use and perceived usefulness of technology adoption among university academic staff in Malaysia. In addition, [14] also ascertained that individualism culture such as perceived effectiveness of using ICT tools affect students' decision to use ICT tool rather than pressure from society member. The result shows that the mathematics students from higher learning institutions in Malaysia make independent decision related to their attitude towards technology use that has potential to promote their higher order thinking skills. The finding is differed from the findings of [1]. This could be due to, in educational context students more focus on the effectiveness or the outcome that they can obtain from the use of technology. Thus, they ignore the social pressure that make them use the technology without gaining any positive outcome.

The second hypothesis of the study that shows significant relationship between uncertainty avoidance and attitude towards technology use is supported. This shows that the respondents of this study only have positive attitudes towards technology if they feel comfortable with the

technology; and the technology provides values and does not pose any risk to themselves. The respondents basically avoid all the uncertainties that can root from usage of technologies. This finding is consistent with that of [41] who suggested that higher uncertainty avoidance inhibit the use of email among academicians in Malaysia. Similarly, [63] surmised that uncertainty avoidance strongly influences behavioural intention of higher learning institution students to use e-learning to achieve academic excellence including development of thinking skills. In addition, [64] also agreed that teachers who feel uncertain of technology use which may cause by factors such as lack of confidence and skills would more likely avoid using technology, in spite of the fact that using technology will enhance their job performance. The finding is consistent with the findings of [1] who claimed that Malaysians has higher uncertainty avoidance behaviour.

As per the third hypothesis, attitudes towards technology use directly promoted higher order thinking skills of students. This shows that positive attitude towards technology influence respondents' adoption of the technology that can deliver academic benefits such as promotions of higher order thinking skills. As highlighted by [28] and [66] use of technology in classroom could challenge students' abilities and activate their motivation, thus may affect their learning performance. According to [32] positive attitudes towards technology affect the thinking process of the students and enable the students to enjoy promising academic benefits. The finding is consistent with the finding of [51] who stated that positive attitudes towards technology use affect the learning outcome of the students. However, [32] argue that attitudes towards technology use do not have direct relationship to higher order thinking skills but has indirect affect through deep learning approach. The current study shows that cultural influences may affect the direct relationship of attitude towards technology use and higher order thinking skills of the higher learning institution students from mathematics disciplines in Malaysia.

In sum, the findings of this study shows that uncertainty avoidance (cultural factor) plays an important role in influencing respondents' attitude towards technology that believed to enhance higher order thinking skills in TEL environment. Uncertainty avoidance significantly affect the attitudes towards technology use indicating the respondents of the study only committed to the use of technology tools that they feel are comfortable, familiar, provide value and do not pose any threats. Meanwhile, the findings also provide evidence that the respondents of the study do not place great importance to the society goal and expectation before deciding to use technology tools that could enhance their academic performance. Finally, attitudes toward technology use directly influence higher order thinking skills. This relationship shows that positive attitudes toward technology is important to alleviate students' higher order thinking skills in TEL environment. The findings of the study suggest that TEL is optimal learning platform for mathematics students with uncertainty cultural values and had positive attitudes towards technology.

Practical suggestions can be drawn from the findings indicating that attitude towards technology use had the significance direct influence on promotion of higher-order thinking skills. First, to create positive attitude towards technology among mathematics students, the higher learning institution management should provide accessibility to learning technologies that that are easy to use, useful and enjoyable to the students. The management is also suggested to provide workshop or training to guide the students to use the technology tools effectively. This could create positive attitude toward technology among the students [2]. Meanwhile, cultural factor especially uncertainty avoidance needs to be taken into consideration when engaging students in TEL environment to foster their higher order thinking skills. This is because uncertainty avoidance provides indirect link to the higher order thinking skills of students, thus it may influence students' attitudes toward technology use.

This study has several limitations. First, the study used convenient sampling technique to collect data. This may influence the generalisability of the results to the target sample. Second, most

of the respondents of the study were from Malay ethnic group, thus multigroup analysis among other ethnic groups could not be conducted. Thus, future study should collect proportional data from each ethnic group in Malaysia to observe the influence of cultural values on different ethnic group in Malaysia. This may provide fruitful information as the Chinese in Malaysia is considered always outperformed the other ethnic group in mathematics. Third, the study only considers the influence of cultural factor and attitudes towards technology use to promote higher order thinking skills in TEL environment. Thus, future studies are encouraged to include more related variables to further explore factors that influence promotion of higher order thinking skills in TEL environment.

5 Conclusion

In this study, the researchers investigated how cultural factors influence attitudes towards technology use to promote higher order thinking skills among mathematics university students in TEL environment. Research results suggested uncertainty avoidance and attitudes towards technology use promote HOTS among university mathematics students in TEL environment. Practical implication that can be drawn from the study is attitude towards technology and uncertainty avoidance are two important factors that determine promotion of HOTS among mathematics students in TEL environment. Promoting HOTS among mathematics students is important for them to secure a job as employers seeking for talented candidates who can think creatively and solve work related problems innovatively. Thus, there is a need to understand the factors that contribute to the promotion of HOTS in TEL environment among mathematics students. The current study provides a recommended scope for higher education institutions to understand the factors affecting promotion of HOTS among mathematics students in TEL environment. Thus, educators and policy makers in higher learning institutions are suggested to take appropriate actions based on the suggested factors to enhance HOTS among mathematics student in TEL environment.

The current study also contributed to people's understanding of to what extend cultural factors and attitudes towards technology use could enhance HOTS in mathematics TEL environment by providing empirical results from one multinational county.

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