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VALIDATION OF CRITICAL THINKING SKILLS SCALE (CTSS) FOR UNIVERSITY STUDENTS

Nadia Anuar[1], Zulaikha Khairuddin[1*], Khairunnisa Mohd Daud[1], Fairuz Husna Mohd Yusoff[1], Syafiqah Johan Amir Johan[1], Salina Sabri[1], Onaliza Satimin[1]

[1]Akademi Pengajian Bahasa, Universiti Teknologi MARA, 40450 Shah Alam, Selangor

Corresponding Author's Email: zulaikha5497@uitm.edu.my

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Abstract

The development of critical thinking skills is paramount for students, notably at the tertiary education level. The objective of this study is to determine the factor structure of an instrument, the Critical Thinking Skill Scale (henceforth CTSS). The instrument utilised in this study encompasses five skills that are important in students' critical thinking skills, namely (1) interpretation, (2) analysis, (3) inference, (4) evaluation, (5) explanation. A two-stage sampling procedure was implemented, and the first stage involved selecting undergraduates to build a pool of samples. Subsequently, snowball sampling was employed in the second stage. Collectively, a total of one hundred eighty-two responses were obtained. The data underwent descriptive analysis, reliability analysis, and exploratory factor analysis (EFA). This 49-item instrument obtained a reliability score of 0.982, which translates as an excellent measure of critical thinking skills. The EFA revealed that the scale retained one component only, instead of the original five, which explains 53.714%. Another notable finding in this study was that one item was removed from the first skill. The validation of this instrument will not only deepen the critical thinking skills measurement literature, but also shed light on the critical thinking sub-skills that need to be cultivated across all learning programmes.

Keywords*: Critical Thinking; Critical Thinking Skills Scale; CTSS; Exploratory Factor Analysis; EFA*

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INTRODUCTION

Critical thinking skill is an essential skill for people to acquire and master. In today's world, there are many challenges that require people to have critical thinking skills where they can navigate and solve complex problems. Bezanilla et al. (2021) mentioned that critical thinking skills helped society to filter a lot of information because

with today's technology, people consume a lot of news and stories. With critical thinking skills, individuals can better assess and filter useful information from the overwhelming amount of news available today. Critical thinking can be interpreted as the ability to act appropriately in a given situation (Altun & Yildirim, 2023). This shows that critical thinking skill focuses on the process and procedure that happen during the problem solving activity rather than focusing on the outcome of the issue. Moreover, promoting critical thinking to the society is crucial where the skills can help people to enhance higher order thinking skills capacity as it can enhance people's attitudes (Janssen et al., 2019). Therefore, equipping people with critical thinking skills may help them to process the information better and decide the best decision that may benefit them.

Introducing critical thinking skills at an early age is also important as students would benefit them in the future. Ng and Jeyaraj (2023) stated that critical thinking skills can be introduced to elementary students through textbooks. Students may be introduced with simple tasks that can help them develop and use their critical thinking skills such as analysis, evaluation, inference, and synthesis. As discovered by Sarwanto et al. (2021), the level of critical thinking skills among elementary students was low due to a few factors such as misconception, relying on memorisation, and not being able to summarise information correctly. However, these critical thinking skills can still be developed from time to time, hence, it should start to be introduced earlier in the education system. Students in pre-university education displayed moderate levels of critical thinking skills (Mahmood & Othman, 2020), suggesting that educators should use suitable and appropriate teaching styles that meet the students' needs in enhancing their critical thinking skills. The methods and approaches that can be used in the classroom setting are problem-based approach (Hussin et al., 2019), inquiry-based approach (Carracedo, 2025) and project-based approach (Asyari & Melia Andari, 2023). Hence, by utilising these approaches in teaching and learning process, it is expected that students' critical thinking skills can be developed and enhanced gradually.

LITERATURE REVIEW

Critical Thinking Skills in Higher Education

Critical thinking is a crucial skill that needs to be acquired by students, especially at the tertiary level (Ahmed & Ibrahim, 2023; Ramsook, 2023) due to the expected tasks and assignments at tertiary level requiring students to apply their critical thinking skills (Ismail, 2023). The importance of independent thinking in shaping viewpoints on diverse topics, issues, and individuals has been well-documented by extensive research such as Sheergojeri (2022). In line with this, fostering critical thinking skills (CTS henceforth) among students has become a fundamental objective in higher education (Noris & Saputro, 2022; Zhang, 2022) as it is a skill sought after by professionals of various industries, making it a highly demanded soft skill in the 21st century (Rios et al., 2020; Tang, 2020). This suggests that students need to be critical thinkers and should possess the skills to analyse and make informed decisions based on knowledge, data, and information while avoiding biases and misinformation.

The essentiality of critical thinking skills is also drawn in the Malaysia Education Blueprint 2013-2025 (MEB) which outlines actionable steps within the classroom (Ministry of Education Malaysia, 2013) to achieve the goal in producing independent thinkers. With Malaysia becoming a more advanced nation, it is therefore of utmost urgency for university students to better equip themselves with this significantly important skill (Anuar et al., 2020). The ability to think critically, to analyse, evaluate, and synthesise information is considered important not only for academic success but also to navigate the issues of the modern world (Mihail, 2022). As such, understanding the development, implementation, and impact of critical thinking pedagogies has garnered significant attention within

educational research by exploring and examining the various approaches, methodologies, and outcomes associated with teaching and assessing these skills.

The development of curricula or content development should emphasise critical thinking and confront students' epistemic assumptions about knowledge and its acquisition process. University faculty expect incoming students to possess critical thinking skills to manoeuvre the vast amount of information and theories encountered during their studies (Zanden et al., 2020). Therefore, various strategies were formulated and tested in diverse classroom settings in ensuring effective teaching and learning of critical thinking skills. For instance, dialogue, authentic instruction, and mentorship could help students to improve their CTS (Kuhn, 2019; Alsaleh, 2020; Okolie et al., 2020). Supporting this, Ahmed and Ibrahim (2023) revealed that the use of an inquiry mind map tool positively influences the integration of critical thinking skills into teaching methods, with significant improvements noted in students' analytical capabilities, problem-solving proficiency, and overall academic performance. The integration of problem-based learning (PBL) was also found to act as an effective method for enhancing students' critical thinking skills (Hussin et al., 2018; Widiastuti et al., 2023). This student-centred approach may influence the development of critical thinking skills in classroom settings. Blended learning has been recognised for its positive impact on students' critical thinking abilities (Mohebbi et al., 2023). Additionally, problem-based learning models, such as the Round Table cooperative learning model, have been proven effective in enhancing students' critical thinking skills (Suryani et al., 2021). Moreover, active learning methods like project-based learning have been found beneficial in developing critical thinking skills among university students (Dimmitt, 2017; Mahanal et al., 2019).

Furthermore, strong problem-solving skills are linked to possessing robust critical thinking abilities (Hasanah & Malik, 2020). Strategies such as developing inquiry-based teaching materials and integrating local culture in science education have been identified as effective approaches to enhance students' critical thinking and communication skills, preparing them for global competition (Hikmawati et al., 2021). Overall, fostering critical thinking skills among students is increasingly recognised as a crucial objective in contemporary education, essential for both academic success and navigating the complexities of the modern world. Additionally, integrating problem-based learning with online tools further enhances the development of critical and creative thinking skills, highlighting the wide-ranging applicability and effectiveness of these methods. By giving students strong critical thinking skills, educators can better prepare them for a world that is increasingly complex and rich in information.

The present literature underscores the significance of fostering critical thinking skills among university students to equip them with the necessary tools for success in their academic pursuits and beyond. Thus, various educational strategies have been explored to enhance these skills, highlighting the pivotal role of critical thinking in students' academic and professional development. Despite the various strategies proposed for fostering CTS, research indicates that students' critical thinking abilities remain moderate (Anuar & Sidhu, 2017; Mohd Abeden & Siew, 2022). This deduction is possibly contributed by several factors that hinder students' ability to enhance their critical thinking skills. Bachtiar (2024) stated that students who lack exposure to the real world may face difficulties to think critically. This could be caused by the methods used by the educators in enhancing and developing students' critical thinking skills. Although educators are capable of teaching the materials, some may not have the expertise in using suitable strategies to help students to develop students' critical thinking skills based on the materials (Sarwanto et al., 2021). Extending on this, some educators utilised a teacher-centred approach that discourages two-way communication with the learners (Bachtiar, 2024). This means educators need to know students' prior knowledge and learning style in order to match appropriate teaching methods in the classroom.

Moreover, with today's technology advancement, students' reliance on digital information (i.e. artificial intelligence) may undermine their critical thinking skills (Siti Aisyah Mohamad, 2024; Farhana Abd Kadir, 2024) and more worryingly, even students at the postgraduate level exhibit only an average level of critical thinking skills (Nurhidayah Mohd Sharif et al., 2022). Thus, in order to improve students' critical thinking skills, understanding what critical thinking is and how it works is of the utmost importance. One attempt at understanding the concept is through understanding the users' or the thinkers' own understanding of the concept.

Scales in Critical Thinking

Several theories, such as Bloom's Taxonomy (1956) and its revised version by Anderson and Krathwohl (2001), have been developed to understand and measure critical thinking skills. Researchers use these frameworks to design suitable assessment instruments. Moreover, Facione (1990), Toulmin (1958), and Paul and Elder (2006) are among scholars who developed the criteria and characteristics of critical thinking skills. Dissen (2023) used two instruments to assess critical thinking skills among health science students and the instruments are the California Critical Thinking Disposition Inventory (CCTDI) and California and Critical Thinking Skills Test (CCTST). CCTST measures the numeracy skills and critical thinking when students give their reasonings in the process of making their judgement towards what they have to do and on what they have to believe based on the task or setting given while CCTDI is developed to assess the mindset and attitude of an individual towards critical thinking skills (Dissen, 2023). Other than that, referring to CCTST, Teo et al. (2023) employ a model, the Learner's Four-Step Model, where students are required to apply, analyse, synthesise, and evaluate the information in portraying their CTS. The elements in the Learner's Four-Step Model are to clarify, ideate, develop, and implement. These elements could help educators to develop suitable approaches that enhance students' problem-solving and critical thinking skills. Another instrument used in measuring CTS is Socratic Questioning (Ab Rahman et al., 2019) which was developed by Paul (1993).

These instruments could assist students to take their time to analyse and evaluate the information before answering and making the most appropriate decision (Etemadzadeh et al., 2013). Despite the moderate level of critical thinking skills exhibited by students, suitable instruments to measure university students' critical thinking skills, specifically in the Malaysian higher education ecosystem, are inadequate. Moreover, it is a challenge to employ an instrument that suitably aligns with the learning outcomes of educational programmes in Malaysian public universities. Therefore, the primary aim of this research is to explore and determine the factor structure of an instrument, the Critical Thinking Skill Scale (CTSS henceforth) adapted by Facione (1990), to measure students' critical thinking skills. Interpretation, analysis, inference, evaluation, and explanation are the critical thinking skills analysed in this study. Therefore, validating and establishing the reliability and factor structure of the CTSS is necessary in ensuring university students' critical thinking skills can be further looked into with more accurate measurements. By establishing a reliable instrument, educators and policymakers can better assess and enhance students' critical thinking development.

METHODOLOGY

This cross-sectional study employed a quantitative research design which utilised a survey to collect data from undergraduate students at a public university in Malaysia at a single point in time (Setia, 2016). A two-stage sampling procedure was implemented, and the first stage involved purposively selecting undergraduates to ensure that the sample possessed the relevant knowledge relevant to the present study. The criterion that was pre-

determined in the selection was that the respondents have completed two courses; critical thinking and academic writing. Subsequently, snowball sampling was employed in the second stage to expand the sample size through respondent referrals.

Exploratory factor analysis (EFA henceforth) was employed to validate the instrument used in this study. Currently, there is no definitive consensus on the ideal sample size for EFA, and the ideal sample size for EFA varies in the literature. For instance, s Sapnas and Zeller (2002) suggest that 50 responses may suffice, whereas Comrey and Lee (1992) recommend a minimum of 300. Aligning with the guidelines by Hair et al. (2014), this study adopted a sample size of 100 which was deemed adequate for detecting significant factor loadings of at least 0.55.

Research Instruments

The CTSS by Facione (1990) was used in this study as the instrument. This scale evaluates five key components of critical thinking which are interpretation, analysis, inference, evaluation, and explanation. This instrument was selected for its relevance and compatibility with undergraduates (Chen et al., 2019; Gürsan et al., 2022) since Facione's (1990) scale has been found effective in helping students conceptualise ideas more clearly (Chen et al., 2019) and in enhancing reasoning and problem-solving abilities (O'Reilly et al, 2022).

The survey consisted of six sections with a total of 49 items, rated on a five-point interval scale (1-Strongly Disagree to 5-Strongly Agree). The first section, demographic section, enquires respondents' programme and current semester. The second section looks into the respondents' self-perceived interpretation skills while the third section gauges their self-perceived analysis skills. These sections are followed by a section which examines the respondents' self-perceived evaluation skills. Subsequently, the respondents' self-perceived inference skills were measured, and the final critical thinking skill measured in this study is explanation.

Data Collection and Data Analysis Procedures

Data collection was initiated after ethics approval was obtained. Class lecturers and class representatives were contacted to obtain consent for the dissemination of the online survey link. Respondents were given a three-week window to complete the questionnaire, during which intermittent reminders were sent to the class representatives to improve the response rate. After one month, a total of 182 responses were received. Following data cleaning, the valid responses were processed for analysis.

EFA was conducted using SPSS to examine the factor structure of the CTSS and uncover the underlying dimensions of students' self-perceived critical thinking skills. The application of EFA is essential as this analysis offers a deeper understanding of the components that make up critical thinking, enabling educators to concentrate on these elements in their instructional strategies (Jais et al., 2021).

The analysis was conducted in five stages as per the protocol detailed by Williams et al. (2010). The first stage observed several tests to assess the suitability of the data in the first stage. The value of Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy should be greater or equal to 0.50. The second condition is that Bartlett's test of Sphericity results should be significant at $p<0.001$ as recommended by Hair et al. (2014), Anuar et al. (2023) and Bahkia et al. (2019). The second stage determined the factor extraction method to simplify the factor structure of a group of items (Williams et al., 2010). In this study, principal component analysis was utilised as this extraction method is the most commonly used in the literature.

The third stage identified the criteria that will assist in determining factor extraction. Scholars such as Costello and Osborne (2005) stress that various extraction techniques must be utilised to ensure that the decision in factor extraction is accurate. Thus, three extraction techniques were used in this study to identify the factors in each section. The first extraction technique used was examining the cumulative percentage of variance of each construct and the threshold adhered in this study was more than 60%. Secondly, eigenvalue >1 was also referred to as a decision maker in factor extraction. Finally, parallel analysis was employed using MonteCarlo PA Output. This technique involves comparing the actual eigenvalues with random order eigenvalues (Williams et al., 2010) whereby factors are maintained when actual eigenvalues surpass the random ordered eigenvalues

The fourth stage involved selecting a rotational method which assisted in determining if a variable might relate to more than one factor (Williams et al., 2005). Varimax rotation was applied in EFA as it is the most widely used orthogonal factor rotation method in analysing the underlying factors (Hair et al., 2014; Shkeer & Awang, 2019). Finally, the fifth stage requires interpretation of the items. In this stage, the variables were examined whether the variables are attributable to a factor and thematising a specific factor. Also, in this stage, factor loadings with an absolute value of below than 0.55 were discarded while items with factor loading values of equal or more than 0.55 need to be retained and measured (Hair et al., 2014). Therefore, these stages were sequentially completed in ensuring that the CTSS is validated in the present research context.

RESULT AND DISCUSSION

This study assesses students' self-perceived critical thinking skills using forty-nine (49) items in the questionnaire which were adapted by Facione (1990). The skills were measured by five dimensions which were (1) interpretation, (2) analysis, (3) evaluation, (4) inference and (5) explanation. Three tests were conducted in testing and validating the CTSS which were (a) descriptive analysis, (b) reliability analysis, and (c) EFA.

Descriptive Analysis

The descriptive analysis revealed that among the five critical thinking sub-skills assessed, interpretation was rated the highest by respondents (M=3.814, SD=.591). This indicates that respondents generally perceive themselves as competent in understanding intentions, recognising expressions and gestures, and providing examples, all of which are important skills that are crucial for critical thinking. Based on Facione's (1990) framework, interpretation skill serves as a core aspect of critical thinking as it supports subsequent competencies such as analysis (Atabaki, 2015). This was followed closely by evaluation (M=3.746, SD=0.598) and inference (M-3.736, SD=0.590). This suggests that respondents also felt reasonably confident in their ability to assess arguments and draw logical conclusions. In contrast, analysis recorded a slightly lower mean score of 3.688 (SD=0.560), while explanation was the lowest-rated skill with a mean of 3.670 (SD=0.611). Despite being the lowest, both constructs still reflect moderately positive self-perceptions.

Notably, while students were able to identify intentional sympathetic phrases and their function in supporting others' claims, they expressed lower confidence in their ability to define abstract concepts which are essential aspects of analysis. This could reflect a challenge in interpreting implicit meanings or adopting alternative perspectives. These findings suggest the importance of incorporating real-life scenarios into classroom activities to help students relate to complex issues and develop stronger critical thinking abilities applicable to both theoretical and real-world contexts (Quraishah at al., 2022).

Reliability Analysis

Cronbach's alpha was used to assess the internal consistency of the items in the survey questionnaire. The second section of the research instrument (interpretation skill) consisted of twelve (12) items and attained a value of 0.944. Next, the third section (analysis skill) had eight (8) items and obtained Cronbach's alpha value of 0.904. This was followed by the fourth section (evaluation skill) and the fifth section (inference skill) scoring Cronbach's alpha values of 0.915 and 0.948, respectively. The final section, explanation skill, which was measured using ten (10) items obtained a value of 0.942.

All five subskills surpassed the commonly accepted threshold of 0.70 for acceptable reliability (Rahlin et al., 2019). This indicates that the items within each sub skill demonstrate strong internal consistency. The overall 49-item survey instrument obtained a Cronbach's alpha of 0.982, indicating that the items are robust measures of critical thinking skills.

Exploratory Factor Analysis

The central objective of this study is to determine the validity of the CTSS in the Malaysian higher education context by conducting an EFA. The instrument was designed to measure five key constructs: interpretation, analysis, evaluation, inference and explanation. EFA was carried out using principal component analysis with varimax rotation which is commonly employed to simplify factor structures and enhance interpretability.

Prior to factor extraction and to assess the suitability of the data, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's Test of Sphericity were conducted. The KMO value was 0.954 which indicates excellent sampling adequacy and strong partial correlations among items. Additionally, Bartlett's Test of Sphericity was significant (X2=7898.990, df=1176, p<o.oo1). These results confirm that the dataset met the necessary conditions to proceed with EFA (Awang, 2010, Bahkia et al., 2019, Rahlia et al., 2019).

The EFA initially identified five components with eigenvalues greater than 1, fulfilling the Kaiser criterion for factor retention (Costello & Osborne, 2005). These five components collectively accounted for 66.162% of the total variance. Specifically, the first factor alone explained 53.714% of the variance while the remaining four factors explained 4.089%, 3.355%, 2.631%, and 2.365%, respectively. This distribution suggests that the first factor has a dominant role in the measurement of students' perceived critical thinking skills, although the additional components contributed meaningfully to the overall construct based on eigenvalue criteria.

However, a visual inspection of the scree plot (Figure 1) presented contradictory results. The scree plot displayed a clear inflection point after the first component.The inflection point indicates a sharp drop in eigenvalues and suggests a unidimensional structure. This visual cue implied that the only one dominant factor underlies the dataset which raised concerns about the five-factor interpretation derived from Kaiser criterion.

A parallel analysis using Monte Carlo simulation was conducted to further scrutinise this discrepancy. The results of the parallel analysis revealed that only the first component's eigenvalue (26.320) exceeded the corresponding criterion value (2.180) from the randomly generated dataset. In contrast, the eigenvalues for the second through fifth components did not surpass their respective parallel analysis threshold, therefore, the second till fifth components were not retained. To further support the finding, factor loading for component 1 was analysed. According to Awang (2012), factor loadings above 0.60 indicate items that should be retained. Out of 12 items loaded onto Component 1, eleven items achieved factor loadings above 0.60. One item, "I can develop an understanding towards a concept and distinguish the ambiguity surrounding it", was removed as

it failed to meet the loading threshold. No cross-loadings were identified which further strengthened the statistical evidence for a unidimensional structure. The final retained component, comprising 11 items, explained 53.714% of the total variance.

In summary, although the CTSS was theoretically developed to measure five dimensions of critical thinking which encompass interpretation, analysis, evaluation, inference, and explanation, the empirical evidence from EFA suggest that Malaysian undergraduates may perceive these elements as part of a singular construct. This has important implications for the application of critical thinking assessments in higher education, particularly in culturally contextualised settings.

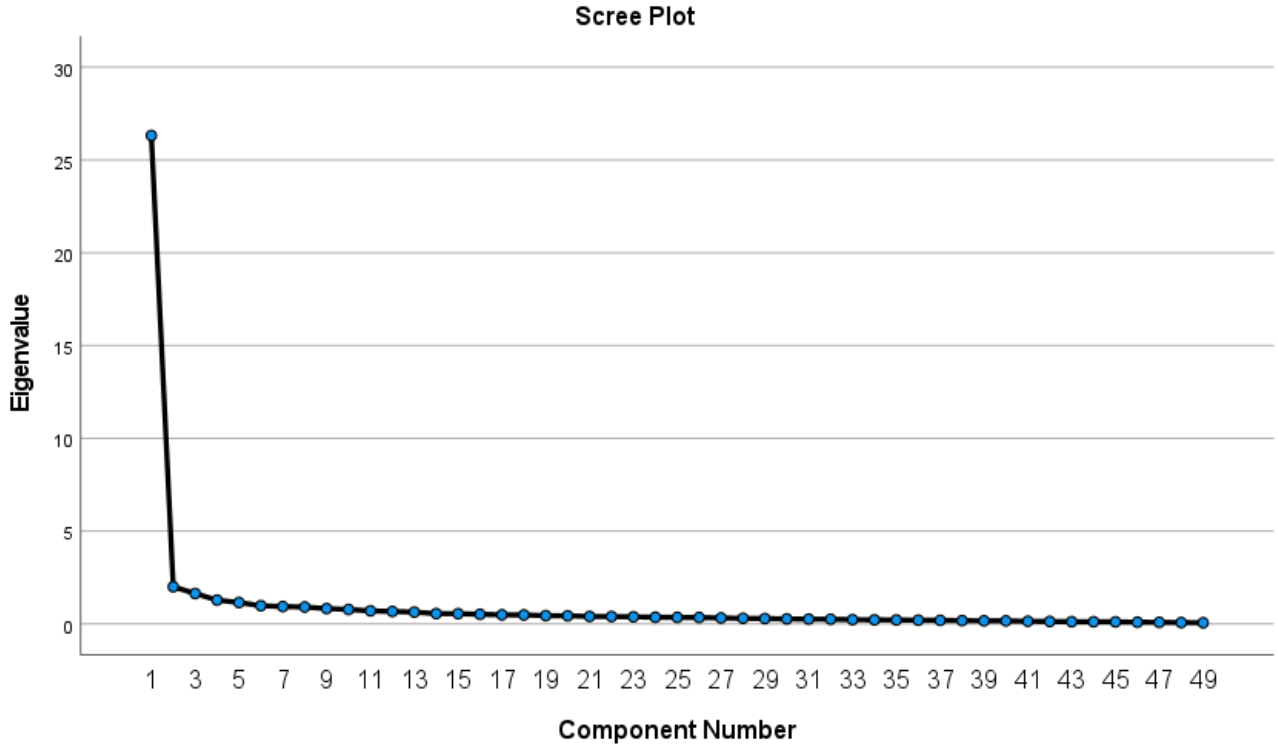

Figure 1: Scree plot

Table 1: Parallel Analysis

Component Number	Actual Eigenvalue from PCA	Criterion Value from Parallel Analysis	Decision
1	26.320	2.180	Accept
2	2.008	2.048	Reject
3	1.644	1.952	Reject
4	1.289	1.869	Reject
5	1.159	1.795	Reject

In EFA, survey items may also be rejected for numerous reasons. A common reason for rejecting items in the EFA procedure is when a simple structure does not emerge initially. In such cases, procedures involve iteratively eliminating measurements that weakly load on factors based on predetermined threshold criteria until a stable outcome is reached where each measurement loads onto only one factor (Conti et al., 2014). This iterative process is crucial in refining the factor structure and ensuring that the retained items contribute meaningfully to the identified factors. Another plausible reason for the rejection of items is the nature of the survey items. The factor analysis results of this study underlined that Item 12, referring to students who can develop and understand the concept and distinguish the ambiguous idea, was removed from construct 1 because it did not achieve the minimum factor loading. The rejection of the item is plausibly contributed by the vague difference between the two sub-skills mentioned (to develop and to distinguish) in this item, making it a double-barrelled question. The concept of a double-barrelled question is to ask for two issues, but respondents would provide only one answer to address both issues (Menold & Raykov, 2022). Menold's (2020) study found that respondents may understand the stimuli asked in the double-barrelled question in different ways and while trying to respond to one issue, they are ignoring the other issue at hand, which may affect the validity of the question.

Among the items that are accepted are Item 3 and Item 9 where the items are referring to students categorising the information systematically and also interpreting the data using suitable instrumentation obtained with a factor loading of 0.678 and 0.689 respectively. These two items employ specific sub-skills (categorise and interpret) and by including detailed scenarios that clarify the construct, shows that these items are easier to be understood by respondents. This indicates that clear and straightforward items are preferred by respondents (Rosellini et al., 2021). In comparison, Item 2 and Item 11 obtained a factor loading of 0.622, 0.623 and 0.623 respectively which mention students can describe the issues objectively and find examples in explaining an idea. The constructs are more abstract in describing the sub-skills that should be employed by the respondents as compared to Item 3 and Item 9. This suggests that respondents might not relate to ambiguous and abstract ideas. However, it is essential to highlight that understanding abstract ideas to evaluate data and arriving at a conclusion through correct reasoning is part of acquiring critical thinking skills.

Although the Malaysia Education Blueprint 2013-2025 (MEB) highlights that obtaining critical thinking skills is part of students' aspiration objectives, the current state of education environment in Malaysia proved otherwise (Abu Bakar, 2023). Baki et al.'s (2016) study conducted on English as Second Language (ESL) students in Malaysia also found that the majority of the respondents encountered problems in judging assumptions in arguments and they highlighted that it might appear to be lack of exposure to activities related to critical thinking in Malaysian classrooms. Thus, it is important to change the educational settings from the conventional teacher-centred approach to a more student-centred approach (Zakaria et al., 2021) which integrates problem-based learning, field-based approach, and creative classroom activities. This shift will facilitate students having more opportunities in the learning process, hence affording students greater autonomy and expanding learning opportunities beyond conventional classroom boundaries.

In summary, the rejection of items in EFA can be contributed by the different factors such as inability to establish a simple structure initially, the absence of a stable theoretical model, and the need to explore alternative item structures. Despite that, these rejections are essential steps in the process of refining the factor structure and ensuring the reliability and validity of the analysis, hence establishing a stronger instrument to assess self-perceived critical thinking skills among varsity students in the Malaysian higher education milieu.

CONCLUSION

This study intends to validate the CTSS by examining students' perceived critical thinking skills in Malaysian higher education. Through descriptive analysis, patterns based on respondents' perceptions were identified, and the internal consistency of the extracted factors was gauged using Cronbach's alpha, confirming the reliability of the scale. The EFA revealed that only one of the original five constructs (interpretation) was retained, necessitating the removal of one item from this construct. The EFA findings are especially useful in education, as they help clarify the scale's underlying structure and the connections between variables in critical thinking research. These insights can help educators and language instructors better understand students' self-assessed mastery of critical thinking skills and encourage further studies to explore factors that enhance or hinder these skills.

The findings of this study would benefit curriculum development, teaching and learning and critical thinking literature. The enriched literature underscores the need for the university curriculum committee to further improve the integration of critical thinking elements and application activities. This understanding can assist educators and language instructors in better assessing students' self-perceived mastery of critical thinking skills. The findings encourage further research into factors that enhance or hinder critical thinking skills, aiding curriculum development and teaching practices. While this study focuses on students from two programmes at a Malaysian public university, the EFA findings provide a foundation for stakeholders to explore university students' critical thinking skills, which have increasingly become one of the most in-demand competencies.Thus, it is recommended that future research expands its scope to include students from various universities including public and private universities to achieve a more comprehensive result and improve the generalisability of CTSS. Additionally, further investigation should explore alternative models of critical thinking that are relevant to students regardless of study programmes. By examining critical thinking skills from various perspectives, educators and researchers can develop more effective teaching practices and curricula to promote these essential skills.

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