

Evaluation of Content Validity for Fundamentals of Computer Science Subject

Maisarah Abdul Rahman*, Mohamad Shanudin Zakaria, Rosseni Din, and Noorafizah Daud

Abstract—Rapid changes in ongoing Information Technology (IT) education demand improvement in the existing learning modules. This is significantly important for Fundamentals of Computer Science (or *Asas Sains Komputer* (ASK)), a subject taught in secondary school level to provide basic knowledge and understandings of Computer Science at earlier stage of learning. Realizing its importance, a study was conducted to evaluate design learning module of ASK to increase students interest in Algorithms. Done from teachers perspectives, the study used a qualitative approach by conducting interviews with five experts from educational background in order to validate the design learning module. The results of the study based on the scores and comments given by the experts regarding ASK design learning module are positive. The feedbacks from the research contribute in development of ASK module thus improving students interest and understandings during the learning process. This also helps in enhancing the quality of Science, Technology, Engineering, and Mathematics (STEM) education as stated in the Malaysia Education Blueprint 2013-2025.

Index Terms—Design learning module, content validity, fundamentals of computer science, STEM education.

I. INTRODUCTION

Computer Science is defined by Peter J. Denning as the systematic study of algorithmic processes: their theory, analysis, design, efficiency, implementation, and application - that describe and transform information [1]. The expertise of computer scientists such as programmers, web developer, data scientists and digital marketers requires ongoing computational thinking skills. These skills and competencies are needed in order to spur technological development in Malaysia. A study by [2] showed that a good Computer Science curriculum can help impart soft skills distinctive techniques such as designing, generating logical thinking, analyzing, formulating, structuring and exploring solutions to problems. These soft skills are valuable and necessary to drive our country's digital economy. [2] also has stated that without the necessary knowledge and skills Malaysia's Digital Economy will not meet the objectives due to lack of expertise to support the technological needs.

Computer Science has been taught and evolved at the tertiary level since the late 1970s. Nowadays, it has become

common at secondary school level in Malaysia where students are taught the basic of computing. Our Ministry of Education (MOE) has introduced Fundamentals of Computer Science (or *Asas Sains Komputer* (ASK) in Malay moniker), taught at the secondary school level as the first step of enhancing technology literacy among younger generations. The goal of ASK is to provide students with computational thinking knowledge and skills [3]. The purpose of this study is to evaluate ASK design learning module. In particular, to elicit ideas from the experts evaluation, to formulate meaningful learning modules that will increase students deep interests in Information Technology (IT), and to encourage students participations through improvement of the learning modules of ASK.

II. LITERATURE REVIEW

The rapid development of technology and information required substantial knowledge and skilled workforce in the field of Science, Technology, Engineering and Mathematics (STEM). The guideline for STEM education in Malaysia listed seven criterias that are being used to design learning modules for STEM education. They are:

- 1) students involvement in inquiry and exploration
- 2) students involvement in productive teamwork
- 3) students abilities to understanding and apply STEM contents
- 4) students are given opportunities to improve answers or products
- 5) students involvement in applying design process skills
- 6) students are required to give variety of answers or solving with justification
- 7) students ability to improve sensitivity towards real world issues or problems

ASK is one such subject that was adopted by our schools in STEM education since 2017 [4]. However, little research has been carried out on its effectiveness in Malaysia. Therefore, in this study we focused more on the evaluation of ASK design learning module. The learning approach is very instructor-centered (as opposed to student-centered) and informative (rather than tacit) [5]. As fast-paced educational technology is revolutionizing teaching and learning methodologies, instructor-centered approach has become less relevant today. Student-centered classrooms and interactive teaching and learning methods are more preferred and widely used [6]. Our approach in teaching ASK must align with the above guidelines. Elements needed to create better designs for this learning module has been identified in [5]. ASK is part of the STEM subjects in the field of technology, therefore adapting STEM guidelines as part of learning strategy is vital.

Manuscript received May 09, 2022; revised June 28, 2022; accepted August 17, 2022.

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A. Design Learning Module

A module, as defined by [7], refers to a hybrid learning package (printed or web-based) which is designed in a planned and systematic manner, combining both the systems and humanistic approaches. There are several criterias required in order to design a learning module for education. We have identified four important components needed to build a learning module: **learning methods, learning strategies, learning theories, and design models.**

The **learning methods** applied a combination of visualization concept and multimedia to build an attractive module for the learning process. The findings in [8], [9] showed that the positive effects of the use of visualization concept in teaching and learning processes motivate students to learn, improves students cooperative performance, and develops students skills of critical thinking approach. Accordingly, [10] claimed the use of the user-friendliness in visualization concept in her research helps improvised understanding, and maintains students capability to memorize information they have learned. The study also agrees on the use of visualization as an appropriate concept for a learning aid. Fig. 1 shows a sample of applied visualization concept in learning module design of ASK.

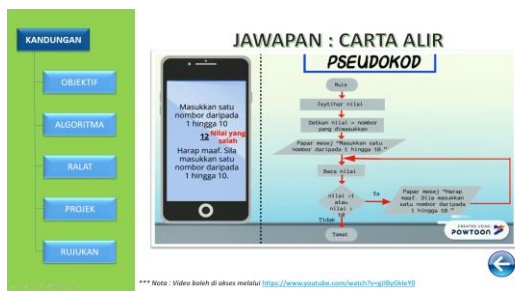


Fig. 1. Interface of applying visualization concept.

Multimedia has been widely used in education as technology for teaching and learning tools. By integrating different content forms of text, image, audio, animation and or video into a single interactive presentation, it has become a very powerful education tool. Multimedia is effective tool in enhancing students performance and motivation towards learning by encouraging discussion, collaboration, problem-solving, and innovation, promoting cognitive processes, and constructing knowledge [11]. Therefore, it is imperative to consider the impact of multimedia for preparing teachers in the proper ways in embedding 21st-century skills in their lessons. Fig. 2 shows an example of the use of multimedia in the design learning module of ASK.

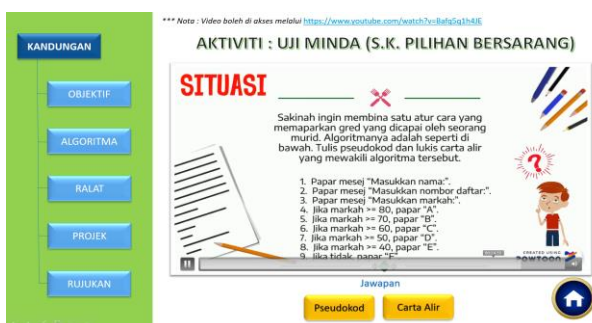


Fig. 2. Interface of applying multimedia.

MOE has also designed a special teaching and **learning strategy** known as the STEM approach for STEM subjects. STEM approach refers to teaching and learning strategies that involve the application of knowledge, skills, and values of STEM integrated to solve problems regarding the context of daily life, community, and environment [12]. This study used STEM approach to focus on problem-solving in achieving the STEM education objectives.

A **learning theory** act as a guide to better understand the technique of an individual receiving knowledge more effectively. Each theory has its own focus and objectives according to readiness, observation, perception, memory and understanding, as well as knowledge transfer [13]. For this study, the Cognitive theory was adapted in the module as it was related to mental processes that required focusing, knowledge, and understanding. This theory also relate to the use of visualization, which is one of our research objectives.

The selection of **design models** is important to design a learning module. It acts as a guideline of proper and effective ways to design a learning module. This research adapted the ASSURE model, which were created by Heinich and colleagues in 1982 [14], as guidelines. The six steps of ASSURE learning process is shown in Fig. 3.

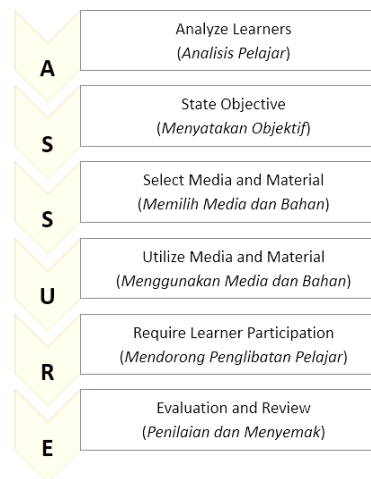


Fig. 3. ASSURE model.

ASSURE model focus on the use of media to build a structured and systematically learning module. Hence, this model is appropriate to be applied in developing ASK learning module.

B. Fundamentals of Computer Science (ASK) Subject

The aim of ASK subject is to provide students with knowledge and computational thinking skills. These skills help students on basic knowledge and skills of Computer Science which involves coding skill and algorithm. STEM also challenges students to become creative, innovative, dynamic and ethical in practicing the culture of Information and Communication Technology (ICT) [3]. The objectives of this subject are:

- 1) compile, analyze and present data or ideas logically and systematically;
- 2) use, detect and correct errors in algorithms and programs using logic and computational thinking;
- 3) solve complex problems through computational thinking using computer -based solutions; and

- 4) apply computer knowledge and skills ethically, prudently and responsibly
- The three topics covered for secondary level year 2 are: -
- 1) Data structure;
 - 2) Algorithm; and
 - 3) Command Prompt

According to [15], [16], there are two issues faced by teachers teaching ASK: the appropriateness of materials used and unattractive learning approach. During the first-year implementation of ASK, there were some problems related to students' mastery in understanding the concept of programming especially in Algorithms [17]. Students ability to master algorithms was rather weak at the beginning. It is for this reason why the study uses Algorithms as research subject. With this evaluation of the design, we hope to successfully determine and improve students understanding towards algorithms.

C. Conceptual Framework

This study was divided into three (3) stages: input, process and output. The input stage was conducted during literature review. The combination of four fundamental elements is identified in order to develop the learning module which are learning methods, learning strategy, learning theory and design model adaptation is compiled. The result from this phase has been used for the next stage.

The process stage was conducted in the design and development process through the ASSURE model in the design of the module. ASSURE model consists of six (6) phases [14] namely i) analyze learners; ii) state objective; iii) select media and material; iv) utilize media and material; v) require learner participation; and vi) evaluation and review

By depending on the input and process stage, the outcome of the process has produced a module that's been used in the output stage. In this stage an evaluation was conducted by the experts regarding the design of the learning module of ASK. Therefore, this study focus on the output stage in order to meet the objective of the research. Fig. 4 shows the conceptual framework for this study.

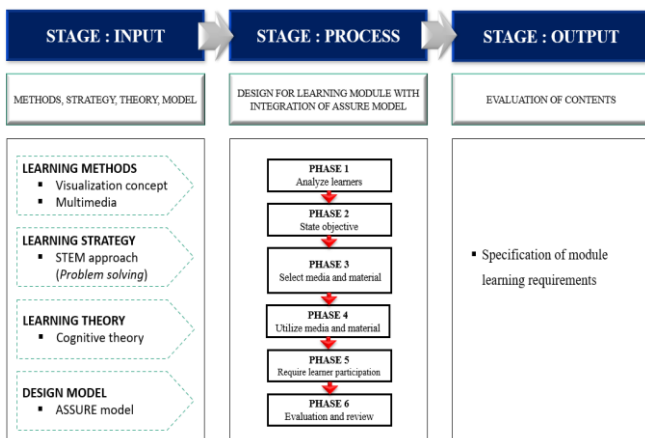


Fig. 4. Conceptual framework.

III. RESEARCH METHODOLOGY

A qualitative research methodology has been applied in this research to gain the expert feedback based on content validity of the ASK module and suggestions to improve the

module in the future. Based on the recommendations from [18], a score of 70 percent is considered a high level of validity. The calculation of content validity is based on:

$$\frac{\text{Expert Score Amount}}{\text{Maximum Score}} \times 100\% = \text{The achievement of the validity of the Content}$$

A. Respondents

This study has been carried out with five experts from educational background to validate the contents of the ASK design learning module. ASK is a subject that teaches the basic knowledge of Computer Science at the secondary level while Computer Science subject is an advanced knowledge for tertiary level. The selection of the experts is based on their expertise in education, especially in Computer Science, to assess the suitability of learning content and understanding according to the student level. Each of the education experts has more than 10 years of working experience in teaching Computer Science. They are capable of identifying the potential and evaluating the design learning module of ASK that will be developed. Their assessments were valuable to gauge long term students interest. Table I shows the profile of each expert.

TABLE I. EXPERT'S PROFILE

Expert Code	Position	Expertise
Expert 1 (E1)	Teacher	10 years
Expert 2 (E2)	Teacher	11 years
Expert 3 (E3)	Lecturer	13 years
Expert 4 (E4)	Lecturer	16 years
Expert 5 (E5)	Teacher	More than 20 years

B. Data Collection

An instrument with six open-ended questions were used to solicit feedback. Each of the questions addressed a specific themes: The application of visualization concept, the use of multimedia, the adaptation of the STEM approach, the syllabus of topic content, the module attraction in students learning process, and comments or suggestions for improvement regarding the ASK design learning module from experts. Interviews were conducted and recorded with the consent of the participants. Every session lasted between 30-40 minutes. During the interview probing questions were asked if the feedback was not sufficient. After the interview session, feedback was summarized and presented to the experts for validation. Then, the encoding process was conducted by arranging the data by keywords, or any meaningful statements based on experts feedback.

IV. RESULT AND DISCUSSION

The findings of the evaluation ASK design learning module consist of the overall content validity. The results are classified according to predefined themes. The questions are based on the application of visualization concept, the use of multimedia, the adaptation of the STEM approach, the syllabus of topic content, the module attraction in students learning process, and comments or suggestions for improvement regarding the ASK design learning module

from experts. The discussion below contains the feedback of the experts based on their responses to the relevant interview questions.

A. The Application of Visualization Concept in Module

Visualization concept have been implemented in many learning modules for other subjects. Thus, this study adapts an element of visualization concept for ASK. Based on the expert's view, most of the experts are satisfied with how the visualization concept helps in improving students interest during the learning process. Table II shows experts response regarding this item.

TABLE II: EXPERTS FEEDBACK REGARDING VISUALIZATION CONCEPT IMPLEMENTED

Summary of application Visualization Concept in module	
<i>Expert 1</i>	Visualization concept is suitable for secondary school. Students can clearly understand the content.
<i>Expert 2</i>	Interesting and convenient.
<i>Expert 3</i>	The concept is great and making it easier for students.
<i>Expert 4</i>	Interesting and nice. Reliable for students to understand and easy to memorize.
<i>Expert 5</i>	No comment.

B. The Use of Multimedia in Module

Multimedia is commonly used as technology in the education area [19]. Therefore, applying multimedia in the module helps to present the content of the subject more attractively. All experts agreed and are satisfied with the use of multimedia in the module. Two experts have given average marks based on the possible improvements towards module navigation. Table III shows the experts responses regarding multimedia use based on the content, presentation and application creativity in the module.

TABLE III: EXPERTS FEEDBACK REGARDING MULTIMEDIA USED

Expert Feedback Based on Elements Criteria			
	Content	Presentation	Creativity
<i>Expert 1</i>	Satisfied	Satisfied	Satisfied
<i>Expert 2</i>	Satisfied	Satisfied	Average
<i>Expert 3</i>	Satisfied	Satisfied	Satisfied
<i>Expert 4</i>	Satisfied	Satisfied	Satisfied
<i>Expert 5</i>	Satisfied	Average	Average

C. Adaptation of STEM Approach in Module Content

ASK is one of the STEM subjects in the field of technology. Hence, the evaluation of this module must be based on guidelines of STEM education. The STEM education in Malaysia has stated that the learning strategy for the STEM subject is based on the STEM approach. Most of the experts agreed this module follows the STEM approach for learning strategy. Expert 5 did not answer the interview question. Table IV shows the feedback given by experts.

TABLE IV: EXPERTS FEEDBACK REGARDING STEM APPROACH USED

Criteria of STEM Approach	Expert Feedback				
	E1	E2	E3	E4	E5
a) Students involvement in inquiry and exploration	✓	✓	✓	✓	-
b) Students involvement in productive teamwork	✓	✓	✓	✓	-

c) Students abilities to understanding and apply STEM contents	✓	✓	✓	✓	-
d) Students are given opportunities to improve answers or products	✓	✓	✓	✓	-
e) Students involvement in applying design process skills	✓	✓	✓	✓	-
f) Students are required to give variety of answers or solving with justification	✓	✓	✓	✓	-
g) Students ability to improve sensitivity towards real world issues or problems	✓	✓	✓	✓	-

D. The Module Content Follow Syllabus of ASK Subject

In order to meet learning objectives, the evaluation of this aspect of the module is important to ensure the content of the module has followed the syllabus. Thus, all the experts with educational background in Computer Science subject will help in determining whether the module complied with the syllabus standard of ASK subject for Algorithm topic. Table V shows feedback from experts regarding the syllabus content of ASK subject.

TABLE V: EXPERTS FEEDBACK REGARDING SYLLABUS OF ASK SUBJECT

Summary of module content based on ASK Subject	
<i>Expert 1</i>	The content is complied with the requirements
<i>Expert 2</i>	The content is right and follow the algorithm topic. Review of each number of items for each topic is needed based on DSKP
<i>Expert 3</i>	The content is complied with algorithm topic
<i>Expert 4</i>	The content is complied with algorithm topic
<i>Expert 5</i>	The content is sufficient. However, you need to revise from DSKP book for the formatting

E. Module Attraction in Students Learning Process

The main purpose of this study is to design a learning module that encourage students interest towards STEM subjects. In order to meet the objective of this study, a validation from experts is needed. For this item, the evaluation based on the module attraction in students learning process by applied visualization concept and multimedia in the module. According to comments received from experts, all experts agreed that the ASK design learning module was able to attract students interest during learning process. The experts also satisfied with the uses of visualization concept and multimedia in the module. The words 'interest' and 'attract' used by the experts indicate satisfaction with the content. Table VI shows feedback of experts comments.

TABLE VI: EXPERTS FEEDBACK REGARDING THE MODULE ATTRACTION IN STUDENTS LEARNING PROCESS

Summary of module attraction in students learning process	
<i>Expert 1</i>	Interesting module and attract students.
<i>Expert 2</i>	Interesting module and attract students.
<i>Expert 3</i>	Agree. The students will impress with this module. The examples provided is good.
<i>Expert 4</i>	Interesting and agree the module can attract students.
<i>Expert 5</i>	Helps facilitate student understanding and attractive

F. Comments or Suggestions for Improvement

In summary, the experts gave positive feedback to help the researchers on how to improve the design learning modules. Table VII shows the expert’s comments and suggestions for improvement regarding the ASK design learning module. According to expert 1, she prefers an additional revision notes at the beginning of a topic. This suggestion gives students a chance to revise previous learning topics. Expert 2 and expert 5 suggest revision of the contents by referring to DSKP book to ensure the arrangement and words use for the topic is standardized. Lastly, expert 3 and expert 4 suggest that exercises are revised and relate to daily life activities such as to create a calculator for basic and advanced formulas. The recommendations by the experts are good practices. However, limitation of this idea requires validation from top education management to ensure the quality of contents are relevant and suitable with learning environments. The details of suggestion from experts can be seen in Table VII.

TABLE VII: EXPERTS FEEDBACK REGARDING COMMENTS OR SUGGESTIONS FOR IMPROVEMENT OF THE MODULE

Summary of comments or suggestions for improvement	
<i>Expert 1</i>	Improvise by add a revision note before start an exercise as student reference
<i>Expert 2</i>	Refer to DSKP guideline book for complete information and include more activities in this module
<i>Expert 3</i>	Suggestion to provide an exercise that relate with the uses of algorithm in real daily life such as calculation using calculator
<i>Expert 4</i>	Add activities in analogy way which more meaningful as life of student
<i>Expert 5</i>	Do checking for the contents of module to ensure it follows DSKP standard based on arrangement of topic and term uses. Other, improve the quality of navigation in this module

Table VIII present summary of feedback regarding ASK design learning module based on overall comments given by the experts.

TABLE VIII: FEEDBACK REGARDING ASK DESIGN LEARNING MODULES

Item for Content Validity	Content Expert					Average (%)	Expert View
	E1	E2	E3	E4	E5		
1.The application of visualization	10	10	10	10	-	80	Accepted

2.The use of multimedia	10	8	10	9	8	90	Accepted
3.Adaptation of STEM approach	10	10	10	10	-	80	Accepted
4.The module content follow syllabus of ASK subject	10	9	10	10	7	92	Accepted
5.The module attraction in students learning process	10	9	10	10	9	96	Accepted
TOTAL						87.6%	Accepted

Each of the items for content validity received positive feedback from the experts. Based on total overall responds given in average by the experts, the score received more than 80%. According to [18], a module considered to achieve a high level of validity if the module scores higher than 70 percent. Therefore, we can conclude that the ASK design learning module have achieved a high level of validity.

V. CONCLUSION

The importance of this study to serves a guideline in designing learning modules for ASK subjects. The design help encourage students active participation during learning process. By adapting multimedia, the implementation of visualization concept in the module illustrates how pseudocode is written and a flow chart is drawn using video and graphic format. The use of multimedia in learning modules (combination of text, sound, image, video, and animation) increases more attractions, improve students understandings and participation during the learning process. Visualization concept is rarely used in ASK learning module compared to in other subjects. In future research, it is recommended that a study to evaluate effectiveness of understandings towards ASK learning module from students perspectives is carried out.

The conceptual framework manages the flow of this research process in three stages. A combination of learning methods (visualization concept and multimedia), learning strategies (STEM approach), learning theories (cognitive theory), and design models (ASSURE model) were used in ASK design learning module. Then an evaluation of content validity by experts is conducted followed by specific themes: the application of visualization concept, the use of multimedia, the adaptation of the STEM approach, the syllabus of topic content, the module attraction in students learning process, and comments or suggestions for improvement. Based on the result for this study, positive feedback was received from the experts with high level scores of content validity for ASK design learning module.

The significance of this study is to produce a good evaluation strategy in designing learning modules that follow STEM approach. There are many learning modules produced by instructors, however neither follow a proper guideline prepared by STEM nor valuated by experts to verify the

content of the modules. Instructors need to be aware that there are guidelines need to be followed in order to produce effective learning modules. This is to ensure the quality and relevance of the subjects being taught. Moreover, the aims and objectives of the subjects and each of the topics need to be achieved.

Therefore, this research provides ideas in designing and improving ASK design learning module. The adaption to the STEM approach is central and acts as support for MOE in improving the quality of education as stated in Malaysia Education Blueprint 2013-2025. By fostering students interest in STEM education from the early stage at the secondary level, it is hoped that our country will gain long term benefits to produce knowledgeable and skillful generations in technology especially to meet the objectives of Malaysia's Digital Economy.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

The authors of this manuscript have worked collaboratively in designing the course, interviewing the participants, constructing the manuscript. All authors have read and approved the final manuscript.

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