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The Importance of Creating a Control Structure Programming Module to Improve Students' Understanding

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Abstract
The landscape of the education system has changed and evolved in line with global needs, driven by the impact of the information technology revolution occurring worldwide. The Ministry of Education Malaysia (MOE), through the Digital Education Policy (2023), has established six core pillars related to digitally fluent students, digitally competent teachers, and digital-based learning materials. Therefore, this study aims to identify the necessity of developing a control structure programming module to enhance the understanding of Form Four students in the Computer Science subject through a qualitative approach. The use of a digital module that includes multimedia elements enhances learning by making it more interactive and accessible. This study involves direct observation of the interactions between three students and one teacher while using the digital module. Additionally, interviews will be conducted with both the students and the teacher to gather their perspectives and experiences regarding the necessity of learning control structures through this digital module. The findings indicate the necessity of using this control structure module to improve students' understanding and assist them in writing control structure programs effectively. The results of this research are expected to provide a framework for educators in the creation or adaptation of digital learning resources. This approach aims to maximize the use of existing technology while simultaneously fostering students' engagement and understanding of Computer Science, with a specific focus on programming related to control structures.
Keywords: Control Structure, Computer Science, Programming Module, Interactive Module

Introduction

The Malaysia Education Blueprint (2013–2025) emphasizes STEM education as a primary focus, with an emphasis on student-centered teaching and learning to create meaningful and enjoyable experiences for students (MOE, 2013). In response to the rapid growth of information and to ensure students are well-prepared for the digital world, the Ministry of Education Malaysia (MOE) introduced the Digital Education Policy in 2023. This policy outlines

essential pillars, strategies, and initiatives aimed at producing digitally fluent students and competent educators.

The fifth pillar specifically addresses the need for high-quality digital learning materials. As a result, the MOE has established digitalization as a core policy, requiring teachers to be proficient in digital education and responsible for developing high-quality digital learning content. It is essential for educators to embrace technological advancements to develop digitally proficient students through the integrated, creative, and innovative application of technology.

In the field of computer science, STEM skills are developed through proficiency and knowledge in exploration, problem-solving, design, and product creation (MEB, 2013). Teachers must combine their technological knowledge, pedagogy, and content knowledge (TPACK) when teaching the Computer Science subject. The teaching and learning process in this field should employ an inquiry-based approach, along with problem-solving and project-based activities, to encourage independent learning among students.

Teachers must be skilled at integrating technology, teaching methods, and content to address the diverse abilities and learning requirements of their students. Therefore, it is essential for educators to be digitally proficient and capable of creating digital learning materials, such as interactive modules, to foster digital fluency among students.

The development of effective digital learning materials can significantly enhance student motivation. This has been demonstrated through the use of programming instructional videos for HTML in Massive Open Online Courses (MOOCs) (Haslinda & Nor Hafizah, 2022; Amanina & Hafizah, 2020). Furthermore, the implementation of interactive teaching aids has been shown to improve students' programming achievements (Haslinda & Hafizah, 2022; Sakinah et al., 2018). Additionally, e-learning materials available on online platforms have contributed to enhancing the learning experience (Shafinaz & Hafizah, 2020). According to Haslinda and Hafizah (2022), employing effective teaching materials and techniques can attract students' interest and motivation, particularly in online programming courses.

This study aims to identify the requirements for developing a control structure programming module based on the ASSURE instructional design model. The module's development will also incorporate elements of differentiated learning, particularly focusing on content and process components. This approach ensures that the control structure programming module is tailored to meet the actual learning needs of students.

Incorporating multimedia elements into an interactive digital module can greatly enhance students' understanding of control structure programming. Unlike traditional teaching methods, which may be boring or hard to understand, digital modules engage students with relevant and engaging instructional approaches. This not only increases students' interest in programming but also improves their comprehension, allowing them to effectively apply programming concepts.

There is currently a lack of research focused on the development of programming modules, particularly those related to control structures. This study aims to investigate the requirements necessary for creating a control structure programming module suitable for Form Four students, as well as how this module can be implemented to enhance their interest in learning programming, particularly in understanding control structures. Utilizing a qualitative approach, this study will gather data through observations, interviews, and document analysis to comprehensively understand the needs and potential of interactive modules in enhancing students' understanding of programming concepts.

The Use of Modules in Teaching and Learning

The modular learning approach is a teaching strategy commonly used by educators to enhance the teaching and learning process. A module is defined as a complete and independent teaching unit designed to achieve specific objectives (Greager & Murray, 1985; Noah & Jamaludin, 2005). Noah and Jamaludin (2005) describe a module as an instructional package related to a particular subject concept. Similarly, Sharifah Alsagoff (1981) defines a module as a set of self-contained yet interconnected components. Additionally, Ali (2016) notes that a module is systematically developed instructional material aimed at facilitating effective student-centered learning.

A module is an individual-based teaching method that enables students to learn independently, with their success depending on their abilities (Sidek Mohd Noah & Jamaludin, 2005). Various definitions of a module highlight its structured and focused nature as a learning package for a specific topic. To be effective in achieving learning objectives, a well-designed module must adhere to a structured framework or model.

According to Ridhuan et al. (2017), developing a high-quality educational module requires a thorough needs analysis. A well-constructed module should be comprehensive and enhance students' knowledge. This viewpoint is supported by Chooi (2018) and Haida (2013), who describe a module as a complete and structured self-learning unit designed to convey and reinforce knowledge and skills. The characteristics of a module are essential for developers, as they provide a clear framework that outlines how the module can benefit its users (Alsagoff, 1981).

A well-organized and systematic development process is essential for creating high-quality and effective learning modules. Hamzah et al. (2020) highlight that the Koswer module, which is designed for C++ programming, helps students gain a deeper understanding of the subject while making the learning experience more engaging. This trend underscores the growing popularity of multimedia-assisted learning in the education sector. Additionally, Fadzilah, Rafiza, and Nurkhaliza (2021) support this perspective, stating that interactive learning materials can further enhance students' interest in programming concepts.

The use of multimedia in education offers numerous benefits. Integrating multimedia into teaching practices has a positive impact on students' academic performance and comprehension, creating interactive and engaging learning experiences (Fadzilah, Rafiza, & Nurkhaliza, 2021). Three main multimedia elements can be incorporated into learning modules: text, images, and videos (Hazwani et al., 2022). Selecting and using appropriate media can enhance students' learning experiences. Before developing an interactive module

for home science learning, Mat Nashir et al. (2022) created a montage display on the main page to capture students' interest. A well-designed learning module should be user-friendly (Nashir et al., 2022) and easily accessible.

Programming Skills in Learning

Programming involves giving instructions to a computer to perform specific tasks. Essentially, a program follows a set of syntactic and semantic rules to create software (Hamzah et al., 2020). The development of the Koswer module incorporated various multimedia elements, including text, graphics, audio, video, and animation (Hamzah et al., 2020). A well-designed programming module should integrate all of these multimedia components.

In Noor Fadzilah's (2021) study, an algorithm and data structure programming application were developed using visual and multimedia approaches to evaluate its usability. The research found that students better understand learning materials when text is combined with graphical representations, rather than relying on text alone (Fadzilah, 2021; Marlina, 2016). Additionally, incorporating multimedia elements is beneficial for learning (Cheah, 2020).

To help students master programming skills, especially in control structures, they need to engage in extensive and continuous practice over time (Marini, Mohd Isrul, & Muriati, 2018). Additionally, teachers must be ready to move away from traditional teaching methods and adopt 21st-century learning approaches (Siong & Kamisah, 2018). This transition requires adapting both the curriculum and instructional processes to better meet the needs of students in their programming education.

Multiple studies have shown the necessity of interactive modules that incorporate multimedia elements in programming education. These initiatives emphasize the significance of an interactive and engaging approach to teaching programming, benefiting both students and educators.

Past Related Studies

Bil	Title	Author	Year	Modul	Programming	Student	Data Analysis	Country
1.	Leveraging the ASSURE Model: The Integrated STEAM Module Development for Year Four Geometry Problem Solving	Farah Aizar, Zaipul Bahari & Salmiza Sale	2024	/		Tahun 4	Qualitative	Malaysia
2.	A Case Study: Analysis of	Siti Haslinda Mukhtar	2022		/	Higher Education	Qualitative	Malaysia

	Weaknesses and Strengths in Teaching and Learning for Web Programming Courses	dan Nor Hafizan Adnan						
3.	Theoretical Design and Development of Online Arabic Courses	Ahmad Zaki Amiruddin, Zulazhan Ab.Halim dan Nurkhamimi Zainuddin	2021	/			SLR	Malaysia
4.	Development of Interaction Module Based on Higher Level Thinking Skills	Zaharah Osman, Azizah Zain dan Mazlina Che Mustafa	2020	/		Children	Qualitative	Malaysia
5.	Development of Proverb Learning Kit for Programming Fundamentals Course	Muhamad Reduan Abu Bakar dan Izwan Che Sham	2020	/	/	Higher Education	Qualitative	Malaysia
6.	Development of Project-Based Learning Modules for the Theme of Ecosystem Balance for Year One Science	Nurul Hazwani Ariffin, Anis Nazihah Mat Daud dan Nur Raihana Mohd Razak	2022	/		Standard 1	Qualitative	Malaysia
7.			2021	/			SLR	Malaysia

	Development of Learning Modules Using Interactive Whiteboard-Based Android Technology Applications on Reading Skills of Preschool Children: A Review of the Theoretical framework	Haiza Hayati Baharuddin, Abdul Halim Masnan dan Azizah Zain				Pre School		
8.	Development of Interactive Multimedia Module for Secondary School Household Science Learning in Malaysia	Irdiyanti Mat Nasir, Ainall Yaqeen Zainal dan Aishah Sulaiman	2022	/		Secondary school	Qualitative	Malaysia
9.	Needs Analysis Study: Development of an Integrated STEM Energy Literacy Learning Module for Primary Schools	Yusmail Jusup dan Sabariah Sharif	2021	/		Primary School	Quantitative & Qualitative	Malaysia
10.	Koswer Interactive Learning for Computer	Norhasyimah Hamzah, Siti Nur	2020		/	Higher Education	Qualitative	Malaysia

	Programming	Kamariah Rubani, Arihasnida Ariffin, Normah Zakaria dan Fazrulhelmi Ahmad						
11.	Development and Usability of Visual and Multimedia-Based Applications for Learning Programming Algorithms and Data Structures	Noor Fadzilah Ab Rahman, Rafiza Kasbun dan Nurkaliza Khalid	2021	/	/	Higher Education	Quantitative	Malaysia
12.	Development of Project-Based Learning Modules on the Theme of Ecosystem Balance for Standard One Science	Nurul Hazwani Ariffin, Anis Nazihah Mat Daud, Nur Raihana Mohd Razak & Norazilawati Abdullah	2022	/		Primary School	Qualitative	Malaysia
13.	Analysis of the Needs for the Module on Integrating Computational Thinking into Programming Education	Mansor.R dan Mohd Yasin.S.F	2019	/	/	Secondary school	Qualitative	Malaysia

14.	Development Of Teaching Modules Based On Local Wisdom In Learning Literature Writing For Students In Elementary School Teacher Education Program	Hety Diana Septika, Mohammad Ilyas, Kiftian Hady Prasetya	2023	/		Higher Education	Qualitative	East Kalimantan
15.	Development and Updating of Educational Modles in The Field of Information Technology	Tyuzhina I.V , Gorbatov S.V dan Kazeev A.E	2024	/	/	Higher Education	Qualitative	Russia

The article explores the development of teaching modules aimed at enhancing students' understanding in various educational settings from 2019 to 2024. The participants include teachers and students from diverse backgrounds across preschool, primary, secondary, and higher education levels. The module development spans a variety of subjects. Of the 15 articles reviewed, 12 employed a qualitative approach, one utilized a systematic literature review (SLR) method, another used a quantitative method, and one combined both qualitative and quantitative approaches in a mixed-methods design.

From a global perspective, the study indicates that most research is centered in Malaysia, with only one study each from Indonesia and Russia. This concentration occurs because the research primarily focuses on the Malaysian education system, with only two external examples included to offer insights into how educational modules are utilized in different contexts. Consequently, the findings mainly reflect the application of modules within the Malaysian educational landscape. Below are several literature reviews of the selected articles:

A study conducted by Aizar, Bahari, and Salmiza (2024) explored the design of a teaching module focused on geometry in mathematics, utilizing the ASSURE model. This qualitative research aimed to create a comprehensive educational resource featuring engaging learning activities. The findings revealed that the developed module effectively addressed students' challenges, fostered creative thinking, and enhanced student performance. The study was conducted in Malaysia with Year Four students.

A study conducted by Mukhtar and Adnan (2022) explored the strengths and weaknesses of online teaching and learning for programming courses among diploma students. The researchers found that teaching effectiveness was affected by lecturers' delivery methods, as well as the instructional materials and techniques used. Effective teaching methods were found to enhance student interest, motivation, and perceptions of programming.

A study conducted by Amiruddin, Halim, and Zainuddin (2021) performed a literature review that analyzed theories related to the development of online Arabic learning materials. This research established a theoretical framework for designing and developing these learning resources, drawing on various educational theories, including cognitive multimedia learning theory.

A study conducted by Zain, and Mustafa (2020) focused on developing a module that incorporates teacher-child interaction based on Higher Order Thinking Skills (HOTS) in storytelling activities. The researchers found that the module had high validity and was well-suited for preschool children. This qualitative study was carried out in Malaysia.

Bakar and Sham (2020), developed a Proverb Learning Kit as a learning module for an introductory programming course at higher education institutions (IPTs) in Malaysia. This qualitative study aimed to promote real-time program-writing outcomes and enhance interactive engagement with hardware.

Hazwani et al. (2022), developed a project-based learning module focused on the theme of "Ecosystem Balance" for Year One Science. The study revealed a high level of expert approval for the module. Furthermore, the online-based learning module significantly enhanced students' interest and critical thinking skills. This qualitative study was conducted in Malaysia.

Furthermore, Baharuddin, Masnan, and Zain (2021) developed a theoretical framework for a learning module using Android-based interactive smartboard technology for preschool children. This study reviewed various theories and concluded that an effective learning module should balance teaching strategies with learning strategies, focusing on instructional quality and student engagement. The framework was developed based on Gagné’s theory, the IEPS strategy, Dual-Coding Theory, and Malaysia’s National Preschool Standard Curriculum (KSPK).

Another study by Nashir, Zainal and Sulaiman (2022) focused on developing an interactive multimedia module for Home Science learning in Malaysian secondary schools. This qualitative study identified the importance of module development in teaching and learning. The findings suggested that the developed module served as an innovative educational resource, facilitating teaching and learning in alignment with government initiatives for future education.

A needs analysis study was conducted by Jusup and Sharif (2021) to develop a literacy learning module focused on science subjects, specifically "Energy and Electricity." The study employed both quantitative and qualitative methods, including student surveys and

interviews with three teachers and four students. The findings revealed significant gaps and issues, highlighting the necessity of developing a module for teaching this topic.

Rubani and Ariffin (2020), developed an interactive courseware learning module specifically designed for computer programming students in creative multimedia courses at higher education institutions. Utilizing the ADDIE model, the courseware focused on the topic of "Functions and Arrays" in programming. The module aimed to enhance instruction and provide new students with early exposure to programming concepts for improved comprehension.

A study by Ab Kasbun and Khalid (2021) focused on developing and evaluating the usability of an educational programming application. The findings revealed that the application, which utilized visual and multimedia elements for programming instruction, demonstrated high usability and effectively supported students' self-learning. This application has the potential to enhance instructional resources for teaching basic programming topics.

Hazwani, Razak and Abdullah (2022), developed a project-based learning module for Year One Science with the theme "Ecosystem Balance." Using the ADDIE model, the module incorporated various project-based learning strategies. The study indicated that the module received high approval ratings from experts and demonstrated both face validity and content validity. It aimed to engage Year One students in learning science while promoting critical and creative thinking skills, and it was designed to assist teachers in implementing project-based learning effectively.

In 2019, a needs analysis study on integrating computational thinking into programming module development was conducted by Mansor R. and Mohd Yasin S. F. This qualitative study aimed to identify the need for developing a programming module for Form Two students in regular secondary schools. The findings indicated that students required structured teaching materials, such as modules, to improve their understanding of programming. Additionally, the study highlighted that low proficiency in programming negatively impacted students' motivation and engagement. It recommended the creation of differentiated instructional modules that consider the diverse learning needs of students.

A study titled "Development of a Teaching Module Based on Local Wisdom in Literary Writing for Primary School Teacher Education Program Students" was conducted in 2023 by Hety Diana Septika, Mohammad Ilyas, and Kiftian Hady Prasetya. This research emphasized the importance of incorporating local wisdom into the training of future educators, creating a foundation for teaching cultural elements that are relevant to their communities. The study, conducted in Indonesia using a qualitative approach, resulted in the creation of a teaching module designed to introduce East Kalimantan to prospective primary school teachers.

A study on the evolution and innovation of educational models in the field of Information Technology was carried out by Gorbatov and Kazeev in 2024. This qualitative research, conducted in Russia with university students, focused on creating an introductory module on information technology that incorporates artificial intelligence. The study addressed self-directed learning within digital technology and computer science disciplines.

The researchers developed a programming module and evaluated its usability as a learning tool.

Conclusion

This study highlights the effectiveness and usability of an interactive digital programming module focused on control structures for Form Four students. Implementing these modules improves students' understanding and helps them accurately write programs using control structures. Literature analyses and various studies have demonstrated that these modules can make the learning process more interactive, engaging, and effective. Interactive programming modules enhance student engagement and accelerate mastery of control structure syntax, making learning more enjoyable and meaningful. This improvement is primarily due to online learning, which allows for real-time interactions among students.

There are still gaps that need to be addressed to enhance the effectiveness of programming modules in teaching control structures, specifically in computer science for Form Four students. First, more research is needed on the impact of programming module applications in teaching computer science subjects to these students. This research is essential for understanding how interactive modules aid in teaching control structure programming and for addressing any challenges that may arise during their implementation. Second, future studies should focus on investigating the challenges of implementing control structure programming modules in teaching and learning, utilizing different sample sizes and research methodologies.

Further research is necessary to explore the long-term effects of using interactive modules on students' programming syntax skills. It is also important to understand the challenges teachers face when implementing these modules in the classroom. Future studies should involve larger sample sizes and diverse research methods to provide a more comprehensive understanding of the impact of interactive modules on programming education. Long-term research should investigate how interactive programming modules impact students' ability to develop writing syntax while catering to individual learning needs. This research aims to provide clearer and more detailed guidance for educators on how to implement interactive modules in both in-person and online teaching.

To address these gaps, future researchers could enhance the effectiveness of interactive programming modules by applying them to a wider range of programming topics. The findings from these studies may help teachers recognize interactive modules as valuable tools for improving students' understanding by developing digital learning materials, such as these interactive modules. These findings highlight the importance of developing interactive modules for programming to improve computer science education at the upper secondary level. By incorporating interactive modules focused on programming control structures, we can enrich students' learning experiences and offer a more flexible and engaging approach to enhancing their programming skills. This study enhances our understanding of interactive programming modules and expands teaching methods to meet the educational needs of the digital age.

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