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Developing E-Mowara: An archipelago-insighted electronic module to train middle school students' computational thinking skills

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Abstract

To face the challenges of Indonesian education in the 21st century, the requirements for abilities are crucial, but the facts show that students are less able to use and adapt their abilities with insights aligned with the identity of the Indonesian nation. For this reason, researchers developed an E-Mowara: Interactive Emodule with an Archipelagic Outlook. This study aimed to develop the E-Mowara electronic module and find out students' responses after using the developed media. The target of this study was class VIII junior high school students with number pattern material. This development research uses a design research type of development study. The data collection technique in this study used a questionnaire with data processing techniques analyzed using percentage data analysis techniques. This is based on the validation results in terms of the material average of 84.35% with the appropriate criteria, and in terms of media, an average of 85.90% with the appropriate criteria. Students' responses to E-Mowara were quite good, with a percentage of 92.5%. Based on this result, the E-Mowara Electronic Module is known as valid, easy to use, and effective in developing computational thinking skills with insights that are in harmony with the identity of the Indonesian nation.

Keywords: archipelago insight; computational thinking; electronic module number pattern

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I. Introduction

Currently, education worldwide, including in Indonesia, is facing the challenges of the 21st century. Some of the challenges that arise are related to several factors, such as technological advances, globalization, and changes in socio-economic dynamics. Therefore, adaptation and innovation are needed in the world of education so that it can keep up with the times (Pare & Sihotang, 2023). The challenges of the 21st century can be seen in the reality of education, which demands that it be reliable and able to accommodate educational needs in the digital era. The orientation of learning in this century is to prepare a generation of Indonesian people who will welcome information and communication

technology advances in social life. In other words, using information technology and the internet will become natural in every activity (Wollschlaeger, M; Sauter, T; Jasperneite, 2017). Students in the 21st century do not only rely on knowledge, but skills also play a role in 21st-century learning (Mardhiyah et al., 2021; Zubaidah, 2019)

The challenges of the 21st century in the scope of learning require several abilities to achieve them. Trilling et al. (2009) argue that the challenges of the 21st century can be answered with 3 kinds of skills or abilities, namely (1) life and career skills, (2) learning and innovation skills, and (3) information media and technology skills. One of the implementations of the challenges of the 21st century is students who can adapt and have competency readiness, especially related to the ability to think about how today's information technology strategies can solve a problem. Here, students must have good thinking algorithm skills, as algorithms in computer programs are orderly and logical. Meanwhile, logical thinking is closely related to problem-solving (Andriawan, 2014; Faradina & Mukhlis, 2020; Kurnia Putri et al., 2019; Yoga et al., 2020). One solution that can be put forward to solve the problem is the ability to think computationally.

Computational thinking is a way to find solutions to problems from input data by using an algorithm and applying techniques used by software in writing programs. However, not thinking like a computer, but computing in terms of thinking to formulate a problem in the form of a computational problem and construct a good computational solution (in the form of an algorithm) or explain why no suitable solution is found (DeJong, 2004; Malik et al., 2019). Efforts to introduce students to computational thinking as early as possible are also implemented in Indonesia, which can be seen from research conducted by Suktiningsih et al. (2021) entitled Introduction to Computational Thinking for MI Teachers and MTs Nurul Islam Sekarbela Islamic Boarding School and Cahdriyana & Richardo, (2020) with the title Computational Thinking in Mathematics Learning. However, from all research related to introductions to improve computational thinking skills, there has not been an introduction effort to improve computational thinking using electronic modules with the archipelago theme. In fact, in computing, integrating modules as learning media with technology is an urgency that must be met in supporting the Industrial Revolution 4.0 in the 21st century, which is marked by massive technological developments. Electronic modules are preferred to improve students' computational thinking skills because of the systematic aspects and student independence. Modules are teaching materials that are arranged systematically in language that is easily understood by students according to the level of knowledge and age of students so that they can study independently with minimal assistance or assistance from the teacher (Abidin, Zainal & Walida, 2017; Nurdyansyah, 2015; Prastowo, 2011)

Ministry of Education and Culture, Directorate General of Higher Education in the substance of Citizenship Education material, material insights into the archipelago is one of the topics that are expected to strengthen student awareness in the midst of the onslaught of challenges in the 21st century, which has a great opportunity to contribute greatly to the process of moral and character degradation, among the nation's children. This is also in line with research conducted by Suwanda & Islamiyah (2020) on students at the high school level, which showed (1) the tendency for students to understand the archipelago's insights was generally at a moderate level, namely 46.99%, (2) the tendency for students' nationalism attitudes in general public is also at a moderate level; namely 51.88% and (3) understanding of the archipelago's insights with an attitude of nationalism has a strong relationship. By taking this theme, it is hoped that the value of student nationalism and their computational thinking skills will increase.

Seeing the importance of teaching computational thinking and the absence of electronic modules in Indonesia, and so that their use can equip students with 21st- and 5.0-century skills while retaining an archipelago perspective, this research aims to develop E-Mowara, an interactive electronic module with an archipelago perspective to train intermediate students' computational thinking ability. That is so true; Pancasila students are obtained as ready to compete in the 5.0 era.

Improving the ability to think computationally and instilling archipelago insights into students is bridged through material on number patterns using the context of the Republic of Indonesia's anniversary. In this regard, there are many Indonesian national insights on the anniversary of the Republic of Indonesia, which require students to have positive character and knowledge. In addition, the Republic of Indonesia Anniversary is an activity that is well known to students in everyday life so that they will more easily understand and follow the learning flow in E-Mowara. The number pattern material was chosen because it can be used as the basis of a problem that can be solved by computational thinking schemes, including decomposition, pattern recognition, algorithmic thinking, pattern generalization, and abstraction (Ioannidou et al., 2011).

II. Research Method

Twenty-three students from junior high school in seventh grade are involved in this research. We used more than one subject because different respondents were needed for each stage. The material used in the development of E-Mowara is Number Pattern material. The emphasis of this type of research is on the development of repeated cycles using formative evaluation. In this study, researchers developed electronic module media to improve the computational thinking skills of high school students who would be tested on activities outside the classroom. This research is a design research type of development study that uses a formative evaluation design model. The stages carried out by the researcher were the preliminary stage, self-evaluation, expert reviews, one-to-one, small group, and field tests (Zulkardi, 2002).

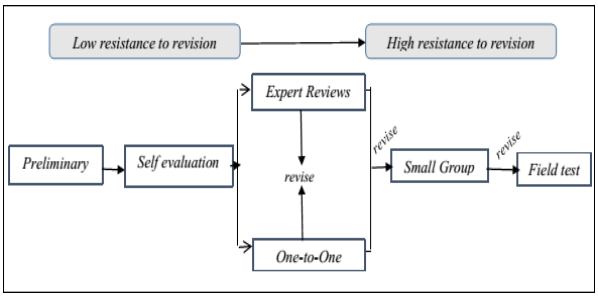

Figure 1. Formative evaluation development flow

In the preliminary stage, the researcher reviewed some of the literature on development research and knowledge of making electronic modules in the form of flipbooks (flipbooks have many features such as images, videos, links, slides, flash, and sound. Researchers will use image features, video, links, and audio for flipmodules. Researchers can include contextual videos about data presentation materials, pictures, quiz links, teacher explanation voices), indicators of computational thinking, and testing outside the classroom. In addition, the researchers also designed an initial prototype in the form of an electronic module media for archipelago insight material. Determine experts who will validate prototypes, determine research subjects, and develop procedures for carrying out research in partner schools.

At the self-evaluation stage, the researcher evaluates and examines the initial prototype. Furthermore, the researcher also designed several instruments, namely (1) media validation sheets, (2) test sheets to determine the potential effect of the media on computational thinking skills, and (3) questionnaires on students' responses to the media.

At the expert review or expert test stage, the first prototype design was validated by observing, assessing and evaluating by learning media experts and math experts at the junior high

school level. The expert test (expert review) results are used to revise the product. After conducting an expert test (expert review), the researcher tested three students individually (one-to-one). The one-to-one evaluation focuses on getting student comments on the clarity of the content, proposing changes or alternatives, and investigating why students get confused or have difficulty. Furthermore, in the small group test activity, the expert revised the second prototype design, and one-to-one testing stages were tested on a small group of students consisting of 5 people; then, the results of student responses were analyzed. Then, the third prototype was tested more broadly in field tests (field tests) at the field test stage. The third prototype, the results of the small group test, was tested on subjects consisting of 15 middle-level students. The students selected were heterogeneous classes based on academic achievement and gender. Teaching materials produced in the field test must meet quality criteria consisting of valid and practical criteria that have been carried out starting from the self-evaluation stage to the small group and fulfilling the effective criteria can be seen from the field test stage itself.

Data collection techniques used in this study include a walk-through and questionnaires. Walk-through is carried out during the expert review and the one-to-one stage to get input on the prototype. Then, the student response questionnaire was given in the small group and field test stages. At the small group stage, the questionnaire focused on responses regarding the practicality of using teaching materials. In contrast, at the field test stage, the questionnaire used was a response questionnaire to obtain student responses after participating in learning using prototype teaching materials.

Data analysis techniques were carried out in several ways, including preliminary analysis of research journals related to computational thinking. Then, the walk-through analysis is carried out by descriptively analyzing the results of the walk-through sheet, taking into account the comments/suggestions from experts. Furthermore, in the one-to-one and small-group stages, an analysis of the results of the questionnaire was carried out quantitatively using a Likert scale. After calculating the response value for each statement item, the next step is to determine the percentage criteria for the subject's response value per statement item as follows.

$0\% \leq NRS < 20\%$	: very weak
$20\% \leq NRS < 40\%$	: weak
$40\% \leq NRS < 60\%$	: enough
$60\% \leq NRS < 80\%$	: strong
$80\% \leq NRS \leq 100\%$	: very strong

(Riduwan, 2018)

Then, create categories for all statement items, namely:

1. If ≥ 50% of all statement items fall into the very strong or strong category, then the subject's response is said to be positive.
2. If <50% of all statement items fall into the very strong or strong category, the subject's response is said to be negative.

III. Results and Discussion

The following are the results and discussion of the electronic development of the E-Mowara interactive module.

1. Preliminary Stage

Researchers analyze the needs of students to deal with developments in the world of education. It was found that in order to face the challenges of Indonesian education in the 21st century, which requires crucial abilities such as media and information technology skills, teachers must be able to cultivate strategic and systematic thinking patterns from an early age to students so that students have adaptability and competency readiness, especially related to the ability to think about technology strategies. Current information can solve a problem. However, students' readiness in these abilities still has a handicap side. They are less able to use and adapt their abilities with insights that are in harmony with the identity of the Indonesian nation. Then, the researcher determined the material that could be filled with topics related to

computational thinking and insight into the archipelago and the research subject, namely number pattern material for SMP class VIII semester 1 students. At this stage, an initial prototype was designed and manufactured using Microsoft Word and Canva.

Initially, the researcher created a design for the character on the cover using several items on Canva. Then, these items were arranged to form a sketch of each sheet of the electronic book that would be created. After that, the design that had been created was downloaded as an image. The image was then placed in Microsoft Word, and then the texts were added, which will form the content of the electronic book.

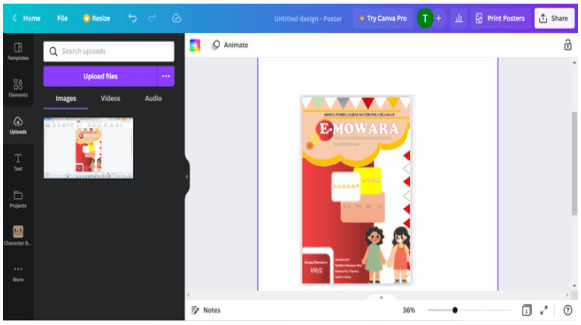

Figure 2. Creating a design in the Canva application

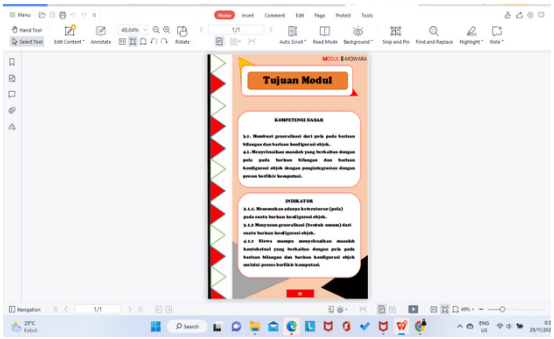

Figure 3. Design making in the Microsoft Word application

Then, the E-Mowara design that has been made is converted into a flipbook using the Flip PDF Professional application. This application allows books or modules in PDF format to be flipped like the original book and can be filled with other features such as video, sound, and links. It can also be integrated with online math games. The following is the process for creating E-Mowara on Flip PDF.

Figure 4. Making E-Mowara on the Flip PDF application

To access using a PC or Gadged, the researcher provides E-Mowara in HTML form, which can be used offline. How to use E-Mowara is enough to access E-Mowara using the HTML link, then the E-Mowara display will appear. The following is the result of the initial prototype of E-Mowara on PC.

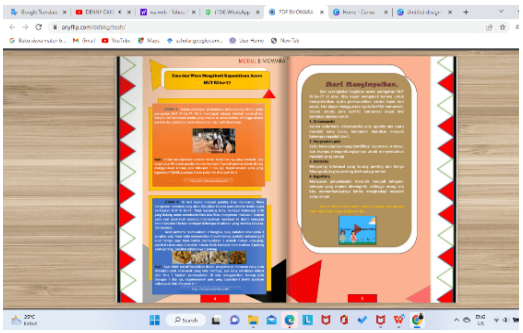

Figure 5. Display of E-Mowara on PC

E-Mowara contains sub-sections such as "Number Patterns in Life", "Concept Introduction", "Concept Deepening", and "Archipelagic Insight Game", which uses the main problem, namely the Birthday (HUT) of the Republic of Indonesia.

2. Self Evaluation Stage

Researchers evaluate and review initial prototypes. In addition, the researcher designed an expert validation sheet and a student response questionnaire for the media. The expert validation sheet consists of a media expert validation sheet and a material expert validation sheet. Furthermore, the student response questionnaire contains module design, material

content, suitability for purpose, and the effectiveness of using modules as learning media.

3. Expert Review and One to One Stage

The validation process by media experts and junior high school mathematics material experts was carried out by giving a Likert scale assessment to the media and material aspects questionnaire. Following are the results of the E-Mowara validation.

Table 1. Results of validation by media experts

Aspect	The Number of Items	Data Mode	Percentage
Module Cover Design	3	3	75%
Module Content Design	8	4	96,8%
Total	**11**	**7**	**85,9%**

Table 2. Results of Validation by Material Experts

Aspect	The Number of Items	Data Mode	Percentage
Content Eligibility	4	3	81,2%
Eligibility of Presentation	4	3	81,2%
Language Assessment	5	3	75%
Archipelagic Outlook Assessment	2	4	100%
Total	**15**	**3,25**	**84,35%**

The validation results show that E-Mowara, in terms of media, is feasible with a percentage of 85.9%, and in terms of material, it is feasible with a percentage of 84.35%. Suggestions in terms of media are 1.) You can set the page length before flipping it or pausing it. 2.) Adjust the font size even if you add pages; 3.) Make it a link to play directly as a quiz preview, not enter the question library. Suggestions in terms of material are: 1.) Use contrasting and suitable colours to make it easier for the reader; 2.) The material is not deepened and incomplete.

Simultaneously with the expert review stage, the researcher conducted tests on students individually (one-on-one), as many as five students who had high, medium, and low abilities, as seen from the math test results. The one-to-one evaluation focuses on getting student comments when using E-Mowara. The three students commented that E-Mowara was interesting; it could introduce them to computational thinking. It was not boring because it has a story about the Republic of Indonesia's anniversary. However, there are some criticisms, such as the test link and video link on E-Mowara not being used, the video volume not being loud enough, and the game not being opened if there is an internet network problem. Comments from experts and student responses form the basis of prototype revision. Figure 6 is the appearance of E-Mowara after revision.

Figure 6. Display of the E-Mowara link after revision

The following is an E-Mowara display for each design.

Figure 7. Cover E-Mowara

Figure 8. Table of Contents of E-Mowara

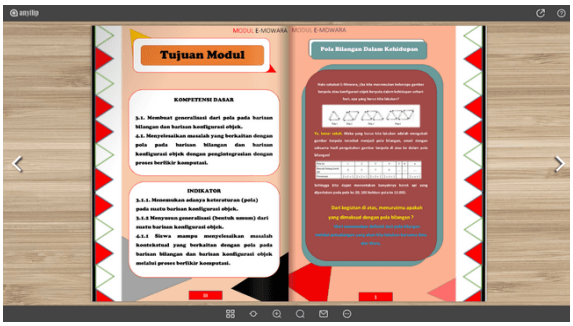

Figure 9. Concept introduction

Figure 10. Content of E-Mowara

Figure 11. Computational thinking concepts

Figure 12. Games

4. Small Group Stage

Researchers used two groups of students, each with 3 heterogeneous students based on high, medium, and low abilities. The small group evaluation focuses on getting student feedback after the second prototype trial and ensuring that the E-Mowara is ready to be tested at the field test stage. Students ask for more questions in the Game Insights of the Archipelago section. Due to time constraints, researchers will add it to the next development of E-Mowara.

5. Field Test Stage

The target of this stage is 15 class VIII students of SMPN 25 Surabaya. The research was conducted through Google Meet to discuss number pattern material that would help computational thinking processes. After that, the students were asked to use the module to understand the material. The material understanding test is carried out by providing an assessment in the form of a Google Form and Quiziz in the module. After that, the researcher asked the students to fill out a questionnaire to use the E-Mowara module. The following are the results of student responses to using the module.

Table 3. Results of the student response questionnaire in the field test stage

Criteria	The Number of Items	Data Mode	Percentage
Content Eligibility	3	4	92,40%
Presentation Eligibility	4	4	93,80%

Criteria	The Number of Items	Data Mode	Percentage
Language Assessment	5	4	93,20%
Computational Thinking Assessment	4	4	92,00%
Assessment of National Insight	3	4	92,00%
Module Cover Design	3	4	90,90%
Module Content Design	8	4	93,20%
Total	**30**	**28**	**92,5%**

Based on the developing result, we know from each criterion in Table 3 that a value is obtained between 90% - 100%, which means it is in a very strong category. Moreover, because > 50% is in a very strong category, E-Mowara media received a positive response. In terms of the introduction and understanding of the concept of computational thinking, E-Mowara is effective for training students' abilities, as seen from the results of students' work in carrying out assignments at E-Mowara. Students can mention what is known and what is asked in the questions at the formulation stage; students can use their knowledge to solve problems at the "Deepening Concepts" stage, and then students can conclude the results obtained to answer questions at the "Let's Solve" stage. This aligns with the research results related to improving students' numeracy skills with the help of learning media conducted by Syah (2020). The results showed the development of learning media for the Scratch module, which was shown for class X TKJ 1 students at State Vocational School 1 Surabaya, where the average value of student learning outcomes after teaching was greater than the average student learning outcomes before teaching. This is obtained from the sig (2-failed) value of 0.000 <0.05, which can be seen from the significant difference in student learning outcomes before and after using the Scratch module learning media. This shows that by using the computational thinking ability module, students have experienced an increase.

The research results show that the e-module is valid, practical, and effective for improving numeracy skills. The development process with formative evaluation methods starting from introduction, self-evaluation, expert review, and one-stage to-one evaluation, small group, field test, and product improvement during development supports the successful development of e-modules to be suitable for use in the learning process. The results of the expert validation and the results of student responses are good because it is caused by several things, namely: interesting module design, material provided according to indicators, easy-to-understand language, readability of texts, learning videos in e-modules, material discussed follows daily life, ease of use, and the emergence of learning motivation. An attractive e-module design can make it easier for students to understand the material Vina et al. (2018). Texts that are easy to read and easy language to understand convey the messages in the e-module to students well (Sudarma, 2015). Learning videos in e-modules can increase student motivation and learning outcomes (Benty et al., 2020; Rachmawati & Erwin, 2022; Sunami & Aslam, 2021). Learning objectives will be achieved if the material in the e-module follows the indicators (Seruni et al., 2020). Material appropriate to everyday life can improve students' numeracy skills (Maryani & Widjajanti, 2020). The ease of using e-modules makes students independent in learning (Diantari et al., 2018; Fitriani & Indriaturrahmi, 2020; Sundari et al., 2023). This study's results align with previous studies.

For insight into the archipelago, the students themselves were shown to have increased through a questionnaire filled in by students after taking part in field tests. Archipelago insight is a crucial thing that

students must have to balance their computational thinking skills with positive personalities as the young generation of Indonesia. This study has provided a reference for educators in providing innovative use of technology that has not been found in previous studies. The weakness of this research is that the e-module development is still limited, and it was tested at Google Meeting in one meeting only. With the e-module integrated into the flipbook with the content of the number pattern on the theme of the Anniversary of the Republic of Indonesia, students are more able to use and adapt their abilities with insights that are aligned with the identity of the Indonesian nation and can increase students' learning motivation in the 21st century.

IV. Conclusion

E-Mowara Electronic Module has met the valid criteria, is easy to use, and is effective in developing computational thinking skills with insights that are in harmony with the identity of the Indonesian nation. E-Mowara was declared valid in terms of material, with an average of 84.35% with proper criteria and in terms of media, an average of 85.90% with feasible criteria. Student response to E-Mowara was quite good, with a 92.5% percentage. E-Mowara is easy to use and operate and effectively develops students' computational thinking skills. It is hoped that there will be a study on the development of learning media to improve computational thinking skills with other technologies in the future.

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