



Development of Heyzine-Based Digibook to Enhance Students' Computational Thinking Skills

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ABSTRACT

The purpose of this research is to develop a digital book about sequences and series using the Heyzine platform so that students of vocational high school (SMK) in tenth grade can improve their computational thinking abilities. This study employs a 4-dimensional model based on the Research and Development (R&D) approach: Specify, Create, Test, and Release. The study involves 10th-grade students in mathematics. Observation, interviews, expert validation sheets (media and content), user response surveys, and computational thinking skill assessments are some of the methods used to gather data. Compared to other platforms, Heyzine's interactive features, multimedia integration, and user-friendliness make it the best choice for this study because they encourage student engagement and computational thinking. Validation results show that the digibook is highly valid and suitable for classroom use. User responses were rated as "excellent." The Effect Size (ES) test result was 1.23, indicating a strong impact of the intervention. Specifically, 69% of students were able to decompose problems into relevant data, and 69% successfully identified patterns to solve the tasks. Additionally, 54% identified key components while excluding irrelevant information, and 51% executed problem-solving steps sequentially and correctly. To sum up, the sequences and series digital textbook developed by Heyzine is a legitimate, interesting, and useful tool for enhancing students' computational thinking abilities in the context of vocational mathematics education.

Keywords: computational thinking skills; digibook; Heyzine

INTRODUCTION

There has been and will be further fast advancements in educational technology. One of the emerging media being widely used is the digibook. Although digibooks offer great potential for learning, some students still struggle to understand the presented content. The lack of interactivity and high engagement in existing digibooks can result in decreased motivation to learn (Dewi et al., 2021). This indicates that not all digibooks are effective in enhancing comprehension. A preliminary study conducted by the researcher with 35 tenth-grade students at SMK Negeri 1 Padoherang showed that only 6% of students were able to solve problems based on computational thinking skill indicators, which confirms the gap in both comprehension and cognitive development in current digibook use.

According to Sari (2022), many digibooks do not fully utilize the available multimedia and interactive features. This limitation can make the learning experience monotonous and less engaging, reducing student involvement in the learning process. This is a serious issue that needs to be addressed to improve the effectiveness of digibook usage. Developing appropriate and relevant content for digibooks poses its own challenge. Many developers struggle to create materials that are not only informative but also engaging for

students. If the content does not align with students' interests and needs, the effectiveness of digibooks will be diminished (Huang, 2020).

Digital books let teachers design dynamic, student-centered courses that are both interesting and demanding. Digital books, sometimes known as digibooks, are electronic copies of printed books available for reading on a range of devices, including laptops, tablets, and smartphones (Harahap, 2020). Digibooks' combination of text, images, videos, and animations provides a more dynamic and interesting learning environment.

To support classroom instruction, the Ministry of Education and Culture has made Electronic School Books (BSE) available. From anywhere and on any device—including smartphones, tablets, laptops, desktop computers, and more—students can access these books. These digibooks, however, are less interesting for students since they resemble traditional printed books with only text and images devoid of learning videos, animations, audio, or interactive quizzes (Yunianto et al., 2019). Teachers thus have the chance to be creative and create digibooks with interesting and interactive content, so inspiring their students and improving the enjoyment of the mathematical learning process.

Teachers might use digibook creation tools including Heyzine, Anyflip, Flip PDF Professional, KVISOFT, Flip HTML5 Web, and others to build a digibook. Every digibook creation tool offers benefits and drawbacks that one can modify to fit the demands of the teacher. Heyzine stands out from other programs in that even in its free edition, links can be used indefinitely. Heyzine also supports smoother user interaction and richer multimedia integration than Anyflip or FlipHTML5, which sometimes restrict interactivity or access in free versions. . Thus, for this development research the researcher decided on Heyzine as the digibook creating tool. Interactive digibooks may be created using the Heyzine platform. Heyzine can improve students' learning environment (Sari, 2022) by including multimedia integration and animations. Using Heyzine in digibook development should produce more interesting and instructive material.

Demand for 4C skills—critical thinking, creativity, teamwork, and communication—drives the evolution of digibook learning tools. Furthermore included is a fifth element called computational thinking, which is the capacity to solve problems methodically and logically by means of a computer approach. Recent studies imply that by providing multimedia integration that promotes active interaction and teamwork among students, media such as digibooks help to apply these five skills in the learning process. (Rahmatullah & Kusumaningrum, 2019).

Computational thinking is one of the fundamental abilities for students nowadays, claims ISTE (International Society for Technology in Education). Kuo & Hsu (2020), who regard computational thinking as one of the most important abilities for the modern era, confirm this claim. Computational thinking skills have a major impact on many different employment fields nowadays (Barr & Stephenson, 2011).

Four elements define computational thinking mostly: algorithmic thinking, pattern recognition, decomposition, and abstraction. Within the framework of sequences and series, decomposition lets students divide a difficult geometric or arithmetic pattern into more manageable steps. By means of abstraction, they can separate relevant numerical patterns from distractions. Spotting the type of sequence used depends mostly on pattern recognition;

algorithmic thinking helps them to create general rules or recursive formulas to solve related problems (Suppiarmo, Mardhiyatirrahmah, & Turmudi, 2021).

Research by Lestari & Roesdiana (2023), which revealed that students often struggle to master fundamental concepts that support computational thinking, such problem decomposition, abstraction, and algorithms, several studies on computational thinking skills have been conducted. Furthermore aggravating this problem is the lack of resources and support from the educational surroundings, which emphasizes the need of more major initiatives to raise the caliber of computer education in Indonesia. Another Munirah (2022) survey found that most students struggled to solve problems involving one aspect of computational thinking skills, namely abstraction.

This result corresponds with a preliminary study on computational thinking skills carried out by the researcher with 35 tenth-grade students at SMK Negeri 1 Padaherang, which revealed that only 6% of students could solve problems based on computational thinking skill indicators. These research results and the preliminary study clearly show that students still have poor computational thinking ability. Meanwhile, Christi & Rajiman (2023) emphasized that mathematical computational thinking skills are crucial in modern education, as they help students solve complex problems systematically and efficiently. Research indicates that computational thinking can enhance students' mathematical abilities. Similarly, Darmawan & Wahyuni (2024) stated that computational thinking skills in the context of mathematics learning show a significant improvement in students' mathematical problem-solving abilities. Therefore, efforts are needed to enhance students' computational thinking skills in mathematics learning.

Considering previous studies on the development of digibook media in mathematics learning, no research has been found on the development of a Heyzine-based digibook for the topic of sequences and series aimed at improving students' computational thinking skills. Therefore, this study aims to develop a Heyzine-based digibook on sequences and series that can enhance students' computational thinking skills.

RESEARCH METHODS

The research method to be used is Research & Development (R&D), which is oriented toward investigating, designing, producing, and testing the effectiveness of the product (Sugiyono, 2016). The product to be developed in this study is a digital learning media (digibook) for the topic of sequences and series.

Developed by Sivasailam Thiagarajan, Dorothy S. Semmel, and Melyn I. Semmel, the 4-D model—define, design, develop, disseminate—is the model used in this study. The 4-D model is advised for the creation of teaching resources, thus it was selected. After that, product trials and validity will help to determine whether the created product is feasible.

The subjects of this research and development study consist of 35 tenth-grade students from class X ULP A at SMK Negeri 1 Padaherang, selected through purposive sampling. Data collection techniques include (1) Observation, which involves analyzing the learning process and the use of instructional media in the classroom, (2) Interviews, where several questions are posed to teachers to obtain necessary data, (3) Validation sheets, which are distributed to two subject matter experts (mathematics education lecturers from Universitas Lampung and UIN Yogyakarta) and two media experts (SMK teachers in the

field of media) for evaluation, (4) User response questionnaires, which are given to students to assess the feasibility of the Heyzine-based digibook for the topic of sequences and series, and (5) Computational thinking skill test questions, which are used to determine the effectiveness of the Heyzine-based digibook in learning sequences and series. The instruments used in this research have been pre-validated using a Likert scale.

RESULTS AND DISCUSSION

The research and development results of the Heyzine-based digibook for the topic of sequences and series can be outlined as follows:

Define

The first phase of product development, the Define stage emphasizes on activities related to needs analysis. In this stage, the researcher gathers information that will serve as the foundation for product development. The initial analysis in this research includes several key aspects: Front-End Analysis, Learner Analysis, Task Analysis, Concept Analysis, and Specifying Instructional Objectives.

Front-End Analysis is conducted to identify learning issues. It was found that many students tend to memorize formulas without understanding the underlying concepts, and there is a lack of instructional media usage. To address this problem, a learning product is needed to help students independently comprehend mathematical concepts.

Design

In the Design stage, data from the Define stage is used as a reference to design the digibook prototype by considering four main aspects. First, Constructing Criterion-Referenced Test, which involves developing tests to measure students' computational thinking skills before and after using the product. This test consists of two open-ended questions based on contextual problem-solving. Second, Media Selection, where the instructional media is chosen to suit students' needs, with the digibook selected to enhance their engagement and independence in learning. Third, Format Selection, which considers the learning approach and students' characteristics, leading to the choice of a Heyzine-based digibook format. Fourth, Initial Design, which involves creating the initial framework of the product, including an introduction (with learning objectives), the content section, and the closing section. The digibook design was graphically created using Canva and then converted into a digibook format using Heyzine. The choice of Canva as a visual design tool was based on its ease of use, availability of educational templates, and design flexibility for non-designer teachers. This supports the principles of efficiency and effectiveness in the development of technology-based educational media.

The inclusion of motivational quotes is not intended merely as decoration, but is designed to support the affective aspects of students. Literature from Boekaerts (2016) indicates that the integration of motivational elements can enhance engagement and foster positive perceptions toward mathematics. Interactive features such as pattern exercises, logic quizzes, and algorithmic-patterned navigation are specifically designed to develop CT

indicators such as pattern recognition and algorithmic thinking. The following is the initial design of the digibook product.

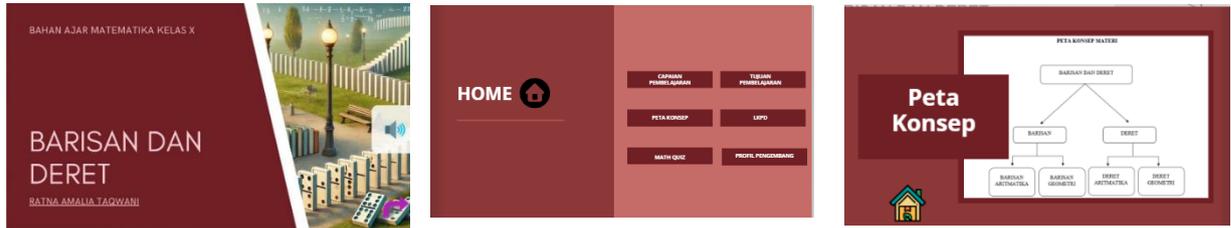


Figure 1. Cover, Home, and Concept Map Design of the Digibook



Figure 2. Material Design, Problem, and Problem Decomposition

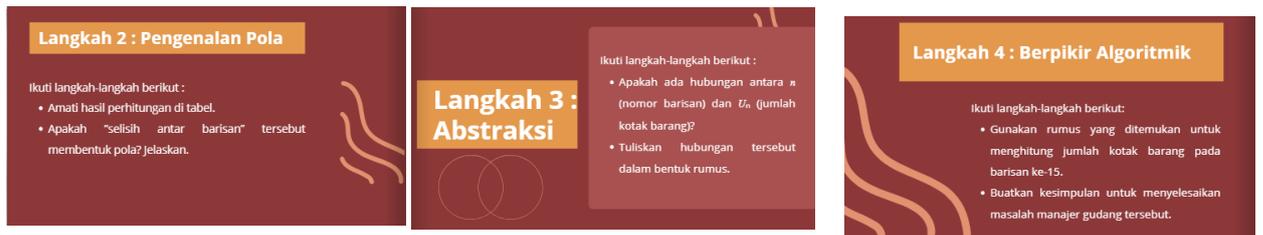


Figure 3. Pattern Recognition, Abstraction, and Algorithmic Thinking Design



Figure 4. Video, Motivational Quotes, and Quiz Design

Disseminate

At this stage, the previously designed product framework begins to be realized into an initial product. Once the initial product is developed, a feasibility test is conducted through the following two stages:

1. *Expert appraisal*, more especially the process of expert assessment meant to establish the validity of the produced good. Media experts and subject-matter experts validate the digibook before it is tested or put into use with consumers. Two subject-matter experts

(validators) and two media experts (validators) do the expert validation to guarantee that the end result satisfies student needs and standards. The validation findings from the media professionals and subject-matter experts follow.

Table 1. Validation Results from Subject Matter Experts

No	Validator	Validation Score/Statement Number										Total Score	Percentage	Category	
		1	2	3	4	5	6	7	8	9	10				11
1	V1	1	1	1	1	1	1	1	1	1	1	1	11	-	-
2	V2	1	1	1	1	1	1	1	1	1	1	1	11	-	-
Total		2	2	2	2	2	2	2	2	2	2	2	22	100%	Highly Feasible

Table 2. Validation Results from Media Experts

Aspect	Score (%)	Category
1	Content and Objectives Quality	100% Highly Feasible
2	Instructional Quality	96% Highly Feasible
3	Technical Quality	96% Highly Feasible
Overall Score	97%	Highly Feasible

Based on Table 1 and Table 2, it can be seen that the validation results from subject matter experts obtained a percentage of 100%, while the validation results from media experts reached 97%. Therefore, it can be concluded that the Heyzine-based digibook on the topic of sequences and series is classified as "highly feasible" for use in learning.

2. *Development testing*, namely a limited trial process conducted with a small group of students to gather direct feedback in the form of responses, reactions, or comments before being used in actual learning conditions. The digibook trial and user response questionnaire were administered to six 10th-grade students. However, the small sample size (n=6) is acknowledged as a limitation for generalization, and the researcher recommends conducting broader-scale trials in future studies. As an anticipatory step, qualitative student response data were enriched through open-ended questions about their user experience. The results indicated that students felt supported in understanding number patterns and appreciated the interactive elements, although some faced access difficulties due to limited devices or signal issues. The following is a graph of the user response questionnaire results from the small-scale trial:

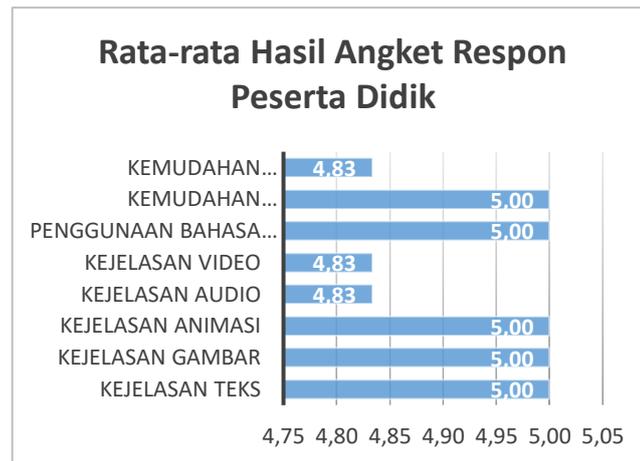


Figure 5. Average Score Graph of Student Response Questionnaire in Small-Scale Trial

Figure 5 shows the average scores for each statement item in the questionnaire completed by six students. The total score obtained from the student response questionnaire is 237, which falls into the "very good" category. This indicates that students' responses to the Heyzine-based digibook on sequences and series were positive. Additionally, feedback and suggestions from students revealed that most of them felt motivated and enjoyed learning sequences and series using the digibook.

Disseminate

Dissemination is the final stage of the 4D development model, aimed at promoting the developed product so that its benefits can be utilized by individuals, groups, or systems. In this process, there are three dissemination steps: validation testing, packaging, and diffusion & adoption.

Validation testing involves implementing the product in real conditions to measure the achievement of development objectives through effectiveness and practicality data of the developed digibook. Pretest and posttest data compared reveals that students' learning outcomes have improved since the average posttest score is higher than the average pretest score. Figure 6 below illustrates the pretest and posttest average score comparison:

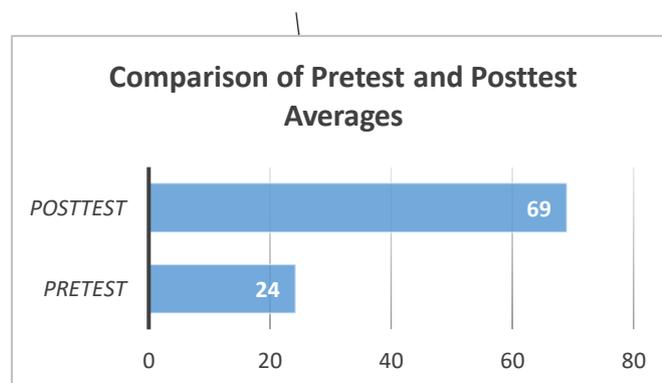


Figure 6. Comparison of Pretest and Posttest Average Scores

Figure 6 shows a difference and an increase in the average scores obtained by students after using the Heyzine-based digibook on sequences and series. Furthermore, when viewed from each computational thinking skill indicator, the percentage of pretest and posttest scores can be seen in Figure 7 below:

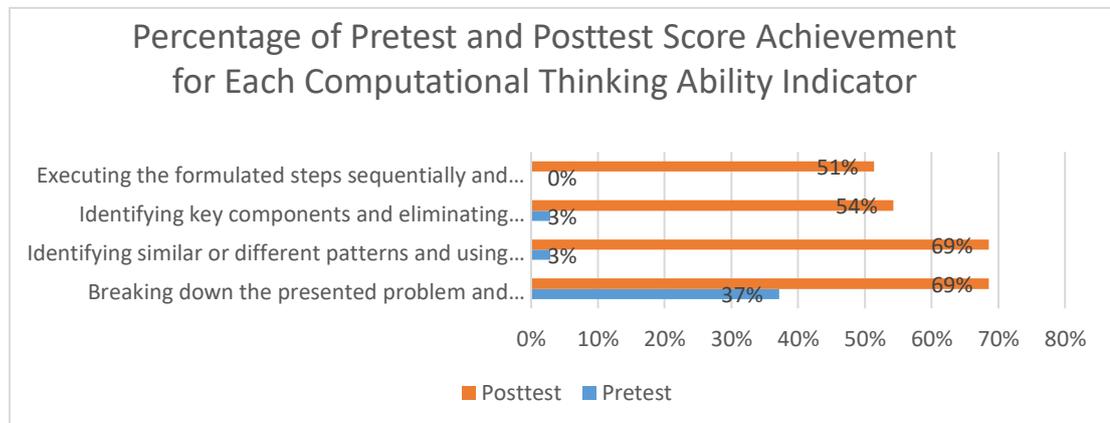


Figure 7. Percentage of Pretest and Posttest Score Achievement for Each Computational Thinking Skill Indicator

Using the N-Gain computation, one could ascertain the improvement in students' cognitive learning results following the Heyzine-based digibook on sequences and series in respect to computational thinking skills. The degree of improvement between pretest and posttest data is gauged using N-Gain. The N-Gain computation is done applying the following formula:

$$Normal\ Gain = \frac{Skor\ Posttest - Skor\ Pretest}{Skor\ Ideal - Skor\ Pretest}$$

The data shows that 16 students (46%) experienced an increase in computational thinking skills categorized as high, while 10 students (29%) showed a moderate increase, and 9 students (25%) experienced a low increase. Based on the N-Gain score interpretation guidelines, the general average N-Gain score is 0.60, falling into the moderate range. With most students displaying a notable improvement in their cognitive learning outcomes, this suggests that learning with the Heyzine-based digibook is successful in improving students' computational thinking skills.

To assess students' responses, each student was given a response questionnaire with scores ranging from 1 to 5 for each statement. The criteria for student responses fall into the "very good" category, indicating that students responded positively to the Heyzine-based sequence and series digibook. This is consistent with studies by Khoerunnisa, Ratnaningsih, and Lestari (2021) and Fauzi, Ratnaningsih, and Lestari (2022) showing that students appreciated studying with digibooks because of their interactive and interesting character.

Furthermore, an effect size test was conducted to find out whether the Heyzine-based digibook helped students to increase their computational thinking capacity. Designed to ascertain the degree of the change from pre-to post-test scores after the Heyzine-based digital book is implemented, the effect size test The results clarify how this teaching approach has improved students's computational thinking capacity.

According to the results, the total score before the test was 848 and after it was 2,416. After the test, the average score increased to 69 from 24 on the pretest. We used an effect size calculation to see how much of an improvement in students' computational thinking skills the Heyzine-based digibook made. The effect size is used to determine the magnitude of the difference in results after using the digibook. The effect size calculation can be carried out using the following formula:

$$ES = \frac{\text{Mean of Posttest} - \text{Mean of Pretest}}{\text{Standard Deviation of Pretest}}$$
$$ES = \frac{69 - 24}{16,12651593}$$
$$ES = \frac{45}{13,84809546}$$
$$ES = 3,235101905$$

These computations yielded an effect size of 3,2351019, higher than 1.00 and falling under the "Strong Effect" classification. This suggests that students' computational thinking abilities are much improved by applying the Heyzine-based sequence and series digibook in learning activities. The effect size results align with studies by Angriani, Kusumayanti, and Yuliany (2020), Khoerunnisa, Ratnaningsih, and Lestari (2021), and Fauzi, Ratnaningsih, and Lestari (2022), which also concluded that digibooks are effective for learning activities.

The Digibook explicitly supports the development of computational thinking indicators, particularly pattern recognition and algorithmic thinking. Visual features such as contextual illustrations of number sequences help students intuitively and systematically identify patterns. Additionally, interactive exercises that require students to identify, extend, and predict number patterns are designed to sharpen their ability to recognize regularities. On the other hand, problem-solving tasks presented in a step-by-step format reflect algorithmic thinking processes, guiding students to follow a logical sequence of steps to reach a solution. Tasks that demand logical reasoning and the sequential application of formulas further strengthen algorithmic thinking. Thus, the content in this Digibook is not only visually engaging but also structured to actively foster computational thinking skills.

Several factors contribute to why students' computational thinking skills improved significantly after using the Heyzine-based sequence and series digibook, and why the three main dimensions of their mathematical beliefs were categorized as high. The Heyzine-based digibook is not monotonous like a regular textbook because it offers various interactive features. Its attractive and user-friendly interface increases students' learning motivation and strengthens their mathematical beliefs. The content is structured by considering computational thinking indicators and is presented in a contextual manner, making it relevant to real-life applications. The material is easy to understand as it includes videos, images, animations, and graphical explanations that support learning. Additionally, quizzes are included as an evaluation tool, allowing students to practice and assess their understanding after studying the material. Moreover, the digibook is published online through Heyzine, making it accessible anytime, anywhere, and on any device (smartphone, tablet, laptop, or computer) connected to the internet, providing students with greater flexibility in learning.

These findings are consistent with previous research conducted by Mulyadi, Wahyuni & Handayani (2016), Watin & Kustijono (2017), Harahap (2020), Khoerunnisa, Ratnaningsih & Lestari (2021), and Fauzi, Ratnaningsih & Lestari (2022).

CONCLUSION

Considered very practical and efficient for use as a learning tool, the outcomes of this research and development generated a Heyzine-based digibook on sequences and series. Particularly in areas like pattern recognition, abstraction, decomposition, and algorithmic thinking, the digibook showed a great influence on raising students' computational thinking abilities. The results show that students made notable improvement in using computational thinking components to address issues concerning sequences and series. This implies that interactive and multimedia-rich materials have great power to improve mathematical knowledge and problem-solving capacity. Thus, it is advised that next research investigate the development of similar digibooks in other mathematical subjects and investigate their possibilities in supporting several higher-order thinking abilities.

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