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DEVELOPMENT OF DIGITAL D'SCRATCH MEDIA IN 21ST CENTURY LEARNING

Ahmad Fadillah[1], Kus Andini Purbaningrum[2], Frena Fardillah[3], Dian Nopitasari[4], Westi Bilda[5], Queen Alfalah Arisanto[6], Juanita Chandra[7]

[1,2,4,5,6,7]Mathematics Education Program, Universitas Muhammadiyah Tangerang, Tangerang, Indonesia
[3]Engineering Study Program, Universitas Muhammadiyah Tangerang, Tangerang, Indonesia
e-mail: fadielalgebra4@gmail.com

Abstract

This research aims to produce a valid and feasible scratch product for use in mathematics learning. The research was conducted using the Research & Development (R & D) method with the ADDIE model. Data collection techniques used validation questionnaires. The instruments used were in the form of validation questionnaires. The product validation results by media experts reached 82.5% and by learning experts 80%, categorized as very feasible for use. After the product was declared feasible and valid, the field test results by users showed an average score of 80.5%, with criteria of being very practical when used. The recommendation from this research is for teachers as a solution for 21st-century digital-based mathematics learning.

Keywords: 21st Century Learning, Digital, Scratch

Abstrak

Penelitian ini bertujuan untuk menghasilkan produk scratch yang valid dan layak digunakan dalam pembelajaran matematika. Penelitian dilakukan dengan menggunakan metode Penelitian & Pengembangan (R & D) dengan model ADDIE. Teknik pengumpulan data yang digunakan adalah kuesioner validasi. Instrumen yang digunakan berupa kuesioner validasi. Hasil validasi produk oleh ahli media mencapai 82,5% dan oleh ahli pembelajaran 80%, dikategorikan sangat layak untuk digunakan. Setelah produk dinyatakan layak dan valid, hasil uji lapangan oleh pengguna menunjukkan skor rata-rata 80,5%, dengan kriteria sangat praktis saat digunakan. Rekomendasi dari penelitian ini adalah untuk guru sebagai solusi pembelajaran matematika berbasis digital abad ke-21.

Kata kunci: Pembelajaran abad 21, Digital, Scratch

INTRODUCTION

The education world is currently forced to change the conventional learning system. Education must move towards a more modern, dynamic, and inclusive direction without lowering the established quality standards of output. The output should not only master science and technology but must also master soft skills. The soft skills in the 21st century include: critical thinking, collaboration, communication, creativity, culture, and connectivity, referred to as the 6C (Aizenkot & Ben David, 2023; Chen, 2023; Özer & Kuloğlu, 2023; Yurt, 2023). Collaboration skills are a type of social interaction and specific learning process in which group members can actively and constructively solve problems (Irwin, 2020; Mertz et al., 2022, 2023; Vance & Smith, 2019). 21st-century skills greatly influence various fields,

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especially in education, and one of them is mathematics education. (Bray & Tangney, 2016; Remillard & Moist, 2022; Xu & Zhou, 2022).

As an effort to facilitate students in learning mathematics, it is necessary to design learning media that supports the development of the abilities they possess (Fadillah, 2018, 2020; Fadillah, Bilda, et al., 2021; Fadillah, Nopitasari, et al., 2021; Fadillah & Bilda, 2019; Syaharuddin et al., 2021). Learning media can help students who are in the concrete operational phase to understand topics in mathematics that are abstract in nature (Ge, 2021; Pakpahan, 2014; Samathayakul & Thamaduangsri, 2022). Learning media that aligns with technological developments is expected to help and address the challenges faced by students during mathematics learning (Ghimire, 2022; Johnson & Barry, 2023). The integration of technology in mathematics education has several positive impacts, namely it can improve learning outcomes, increase teaching effectiveness, and develop conceptual understanding, thus providing many benefits and conveniences in the learning process (Bahçekapılı, 2023; Venn et al., 2023; Wang, 2022). Learning in the era of the industrial revolution 4.0 demands teachers to utilize technology in the learning process so that learning becomes easier and can improve student learning outcomes (Handayani & Rahayu, 2020). The use of technology in the education process plays an important role in the learning process (Shahin & Arfaj, 2022; Tsihouridis et al., 2018). Mathematics learning media that can be developed and utilized through technology includes the use of the Scratch application. Scratch is an application used to design, analyze, and present in the form of animations for use in learning (Sutikno et al., 2019). Scratch is designed for exploration and experimentation, thereby supporting different learning styles of students (Setiawan et al., 2021). Learning media using Scratch can make students more enthusiastic about following lessons and foster creativity in thinking (Calder, 2018; Nuraenahfisah & Toheri, 2013). Scratch is an educational application program that can be used as a learning tool in application development (Kwon et al., 2018; Pratama, 2018; Tan et al., 2020). Norizwan Ideris et al. conducted a study to test the effectiveness of using Scratch software as a teaching aid in collaborative learning and its effectiveness in utilizing higher-order thinking skills (HOTS) among sixth-grade students participating in programming subjects (Ideris et al., 2019). This research was conducted to determine the effectiveness of Scratch software as a teaching aid in collaborative learning and its effectiveness in utilizing the High Order Thinking Skills (HOTS) of sixth-grade students participating in programming subjects.

Quantitative instruments are used to identify the level of HOTS (Higher Order Thinking Skills) of students and their responses in using Scratch as a teaching tool. The results of the questionnaire scores indicate that students' responses to the use of Scratch as a teaching tool are classified as high. This shows that they agree with the use of Scratch, as it is easy to use and able to facilitate their learning, especially in programming education. Students enjoy using Scratch as a learning medium for programming subjects, particularly in collaborative learning, because Scratch has successfully improved students' scores in tests and their higher-order thinking skills (HOTS). A.M. Ortiz-Colon and J.L. Maroto Romo have analyzed the impact of using Scratch on High School students (Ortiz-Colón & Romo, 2016). The results of the study show that with the use of Scratch language, students are more enthusiastic about learning and achieve higher grades. In addition to impacting students' motivation and grades, the use of Scratch can also improve school performance. The Scratch programming language from the teachers' perspective allows for integration from interdisciplinary sharing of knowledge such as Social Science, Geography, Natural Resources, and Mathematics.

Several studies show that the use of Scratch in the classroom can enhance learning activity, motivation, and effectively improve student learning outcomes (Ayun, 2021; Hussain, 2018; Kristinawati et al., 2018; Sulistyaningrum et al., 2019; Verschaffel et al., 2019). However, there has not been any specific research related to Scratch that facilitates the improvement of students' collaboration skills.

METHODS

The research and development model that will be used in this prototype testing is the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) which is limited to the stages of Analysis, Design, and Development. The practicality test of the product was conducted at SMPN 34 Tangerang with a total of 30 student respondents. The types of data used in this research are qualitative and quantitative. Quantitative data is obtained from expert and student validation questionnaires, while qualitative data is obtained from suggestions and feedback received from experts.

RESULTS AND DISCUSSION

The development of technology today is growing rapidly and encompasses almost all areas of life. One concrete example is the shifting interest of children towards technology,

which should be utilized in the process of virtual technology learning. Children are willing to spend hours playing games on their smartphones. Therefore, children's interest in technology should be leveraged in the learning process conducted by teachers in the classroom. Sometimes, students experience boredom, which leads to them feeling sleepy in class, ultimately hindering the effectiveness of the learning process. There are several factors that cause this, one of which is that the learning is centered solely around the teacher, resulting in students being less active in their learning.

Students' interest in technology must be absorbed by teachers and used as a way to make learning at school enjoyable for students and to ignite enthusiasm for learning, with the ultimate goal of creating effective learning so that the material taught by teachers can be well understood by students. Therefore, the development of technology-based learning media is very much needed at this time, and of course, teachers' competence as educators is required to better understand technology in order to apply this learning media.

The development of technology today is very rapid, there are many software options that teachers can utilize as learning media. Scratch is one of the software that has been widely used as a learning medium because it offers many conveniences such as its small size, being free of charge (gratis), and not requiring an internet connection to operate once the Scratch application is installed. Scratch also supports many types of projects such as stories, games, simulations, and animations, making it appealing to individuals of all ages from children to adults in creating projects using Scratch.

This research resulted in a Scratch product to support the mathematics learning process in the classroom. The model used in this research is the ADDIE model. The resulting product was first validated by competent and credible experts related to the material and media. The product validation sheet is adapted from (Amrina et al., 2023; Artalia et al., 2022; Rangkuti et al., 2023). The results of the validation by experts can be seen in table 1.

Table 1. Results of Expert Validation of Materials and Media

Experts	Aspect	Score	Maxsimum Score	Percentage	Category
Material	Learning	16	20	80%	very worthy
	Material content	17	20	85%	very worthy
	Average	**16,5**	**20**	**82,5%**	**very worthy**
Media	Appearance	28	35	80%	very worthy
	Programming	12	15	80%	very worthy
	Average	**20**	**25**	**80%**	**very worthy**

The product validation results by media experts were 82.5% and by media specialists 80%, categorized as very feasible to use. After the product was declared feasible and valid, the next stage was to conduct practicality testing by users involving 25 respondents from SMPN 34 Kota Tangerang. The validation sheet for the media practicality test was adapted from (Fauzi et al., 2022; Jannah et al., 2020; Khoerunnisa et al., 2021). The results of the practicality test by users can be seen in table 2. The results of product practicality testing by users show that the average score from the field trial reached 80.5%, with the criteria of being very practical when used.

Table 2. Results of Practicality Testing by Users

Assessment Aspects	Percentage	Category
The language used	75%	Practical
Material relevance	79%	very practical
The use of animation	83%	very practical
product display	85%	very practical
total score	**80,5%**	**very practical**

To confirm the responses from the open-ended survey, interviews were conducted with 3 participants (A1, A2, and A3). The results of the confirmation during the interviews revealed several aspects that were not explained in the survey answers. A1, A2, and A3 stated that the material was complete, easy to understand, and creatively designed. However, there were different preferences regarding the use of music; A2 felt that the music made it more engaging, whereas A3 felt distracted by the music. A suggestion was made to provide an on/off button for the music. Regarding the function of the button, A1 reported no issues, unlike A2 and A3 who faced challenges because they clicked the button before receiving instructions, causing the sound to stack up. Furthermore, regarding interest, A1, A2, and A3 claimed that this game was interesting because it was unique or that media like this was rarely encountered. A1, A2, and A3 also felt happy and amazed after playing this game, which can increase user interest in the learning process.

The purpose of this prototype innovation is to produce the D'Scratch product, which is an online educational medium based on Android that is easily accessible anytime and anywhere. The target of this prototype innovation is to improve students' collaboration skills, as well as to enhance students' motivation to learn mathematics. The benefit of this research is the creation of a mathematical educational product as an alternative learning resource and

an online mathematics learning medium based on Android that is favored by students, as it can be accessed anytime and anywhere. The expected outcome is that the D'Scratch product effectively enhances students' collaboration skills. In addition, with the game specifically designed to solve problems, players are trained to develop self-directed learning abilities, the ability to apply knowledge in practice, analytical skills, the ability to synthesize information, and mathematical critical thinking skills.

D'Scratch is an educational product consisting of one main module which is the material of probability. Each module contains games, animated videos explaining the material relevant to the module, and exercises corresponding to the main material of the module. The main development of this prototype is to add a confirmation feature at level 2 after players watch the video. Therefore, to measure the players' understanding of the content of the video provided, it is necessary to add a confirmation feature that contains questions related to the video content at level 2. The appearance and features of the scratch product can be seen in **Figure 1.**

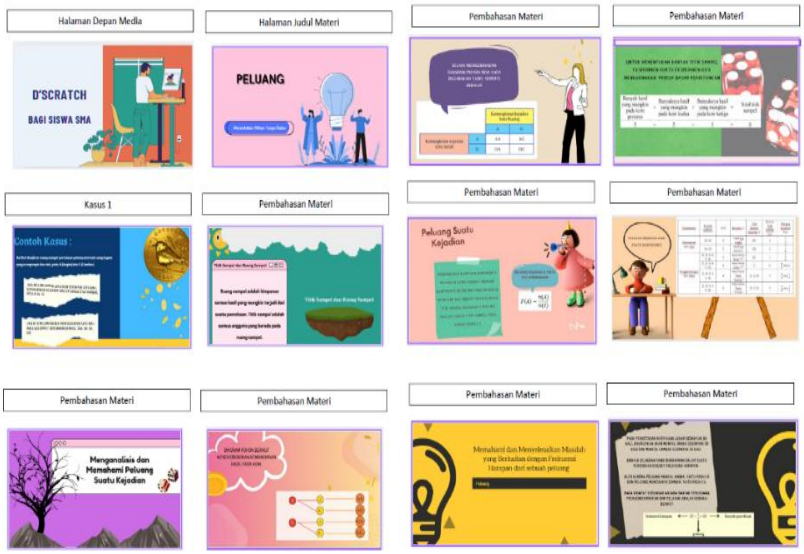

Figure 1. Appearance and Features of the Product

The research and development model that will be used in the testing of this product is the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). However, for the research related to this Scratch product, it only goes up to the Development stage. The series of product development stages includes an analysis stage, where in this initial stage the researcher conducts observations in the classroom when the teacher is teaching in order to

identify what needs to be added to the learning process to create a pleasant and comfortable atmosphere for students and to prevent boredom during classroom learning. From the observations made by the researcher, it was found that the use of Scratch-based learning media in mathematics education has not been implemented.

The design and development stage is carried out by choosing media Scratch version 3.6, which is considered the most appropriate based on the previous analysis stage. The selection of media format used in the Scratch application created by the researcher includes images, text, and also animations added to the media to make it appealing and not boring for students when presented. At this stage, there are 2 very important steps to proceed to the next stage. The first step is for the researcher to create a flowchart in the Scratch application. At this stage, the researcher selects the sprite to be used, and after selection, the researcher creates a block description for the sprite to be used according to the commands that will be executed by this sprite. The block description can be seen in **figure 2.**

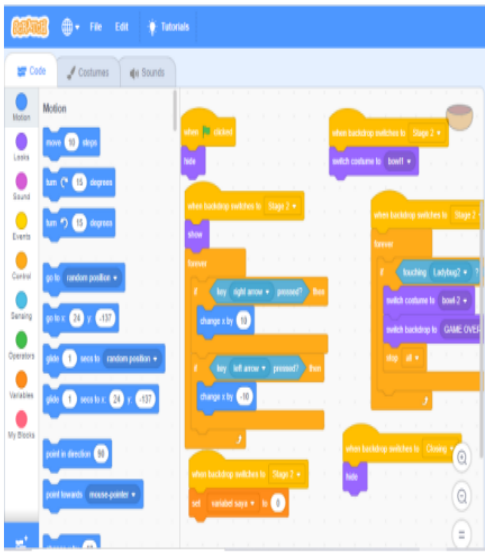

Figure 2. Result of Creating Block Descriptions on Sprite

The second step, the researcher creates the backdrop and supporting images as well as the materials to be included in the developed media. At this stage, the researcher creates the backdrop and supporting images that are relevant to the material.

After the developed media is completed, there are 2 steps to declare that this developed media is suitable for use, namely the validation stage by experts and testing by users. The validation by experts is conducted by material specialists and media specialists.

This expert evaluation is conducted to review the products developed by 2 experts, namely a material expert and a media expert, who are expected to provide good suggestions and input for the researchers regarding the developed product. The results of the validation by the experts indicated that the produced product is valid and suitable for use with scores of 82.5% and 80% in the very suitable category. After the product is declared suitable and valid, the next stage is to conduct a practicality test by users involving students from SMPN 34 Kota Tangerang with a total of 25 respondents and an average score reaching 80.5% with a very practical category when used.

CONCLUSION

The Scratch products produced have proven to be feasible and practical when used in the mathematics learning process, based on the validation results from experts and users. This educational media product is designed to develop students' collaboration skills, certainly with adjusted playing rules. The advantages of this Scratch product are based on the trial conducted by users in the very practical category. Therefore, it is necessary to conduct trials on a larger scale to see the consistency of its effectiveness.

This research recommends to specialists and the general public to take advantage of scratch media as an alternative for using digital-based learning media. For further development of this product, the researcher suggests that it should ideally be implemented on different platforms and include drawing features to support practical learning activities.

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