Development of digital comic for science learning in elementary school

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Abstract. This study aims to develop digital comics for learning science in elementary schools. Digital comics make it easier for students to learn science both online and online. The method used is research and development. The method used in data collection is a questionnaire. Research and development results: (1) The development research process is carried out with several stages adapted from the Plomp development model. The stages: Initial Investigation, Design (design), Realization (construction). The initial investigation phase includes curriculum analysis, material analysis, and analysis of learning objectives. The design phase includes the preparation of material, media selection, format selection, and digital comic design. The realization phase (construction) includes finished products in the form of applications (.apk).

1. Introduction

Current technological developments require teachers as professional educators to be able to prepare learning media. Technological advancements can improve the quality of learning media in the form of digital teaching materials, in the form of resumes or documents in digital format, which have many benefits for learning media [1]. Heinich et al states that: Media can be used effectively in formal situations where students work independently or the teacher works with other student groups [2]. The media plays an important role in student education. Computer and network technology media are applied to learning situations, including synchronous and asynchronous network learning, to break through time, location, and schedule constraints, and to achieve individual student-centered learning [3]. The most common use of media in teaching situations is for additional support from instructors in the classroom to enhance learning. Practical teaching strategies can be developed by combining with current teaching trends and extracting the advantages of digital learning to achieve teaching effectiveness [4]. Digital-based media innovation can be a solution to meet today's challenges. As technology develops, the learning process must be adaptable. Software and hardware for many digital teaching platforms have been developed, a variety of digital teaching materials have been produced, and schools have actively introduced different digital teaching platforms for teaching, hoping to promote student learning outcomes [5].
Technology can support and support the effectiveness of learning. Digital teaching aims to make students actively participate in learning activities to achieve specified learning outcomes [6]. With the use of technology that is currently developing in a positive direction, it is certainly able to minimize the negative impacts of the rapid development of technology. Digital media emphasizes learners learning different knowledge and new technology networks with digital tools to promote the ability to use information technology [7]. Here the teacher's role is very necessary in exploiting the potential of digitalization with the ability to innovate and be as creative as possible to create a learning medium that develops according to the times. One way to make learning more interesting and not get bored quickly with the use of technology is to develop digital-based comics. Comics are currently a very important educational resource [8]. Comics are images arranged in a deliberate sequence, intended to convey information or produce an aesthetic response from readers [9]. This means that in making comics it has to go through the stage of making images. Whereas comics are sequences of images arranged according to the purpose and philosophy of the creator until the message of the story is conveyed, comics tend to be given the letters needed according to their needs [10]. Comics can help increase student interest in learning and become supporters of the delivery of science learning concepts [11]. Scientific comics will convey educational knowledge, not only as a fantasy or problem [12]. Comics are instruments that support communication in learning [13]. Comics help identify norms and beliefs in society through common sense based on visualization and language [14]. The purpose of this research is to develop digital comics to study science in elementary schools.

2. Methods
The method in this study uses research and development (R&D). Research and development methods are research methods used to produce certain products. This research uses the Plomp development model. Learning media that use the application articulate and support for Android with the .apk format.

3. Results and discussion
Digital learning is very important in the learning process. Digital learning as the fastest growing learning mode in recent years as well as the mainstream of learning in the future [15]. Digital learning as delivery with digital forms of media such as text or images through the internet and the learning content provided and teaching methods is to enhance student learning and aims to increase teaching effectiveness or promote personal knowledge and skills [16]. One of the digital learning media that is easy to use is digital comics.

The procedure for developing digital comics using the Plomp model has several stages:

- Initial Investigation Stage. The activity carried out is the identification and study of existing problems by conducting observations and interviews. Observations were made to observe problems related to natural science learning material. Also, at this stage studies the development of digital comic innovation as an interactive learning media.
- Design Phase (Design) In this stage digital comics are designed as interactive learning media with appropriate and supportive designs to facilitate students in learning the material.
- Realization Stage (Construction). At this stage is the realization of the design of learning media that has been created and produced Prototype as a realization of the design results of the model.

The steps of making digital comic products for learning science in elementary schools. Stages in product development by manually designing, scanning, layout settings, giving color with Photoshop, giving balloon sentences after that the process of digitizing android is done using PowerPoints, articulate applications, support for android with .apk format. Which can be operated through android offline and online gadgets.
3.1. Design comic drawings

Figure 1. Comics created manually.

Figure 2. The image is thickened with a drawing pen.

3.2. Image scan process

Figure 3. After thickening with a drawing pen, a picture is scanned.

Figure 4. Computer scan results.

3.3. The process of coloring comics

Figure 5. Image coloring with Photoshop program.
3.4. Digitization process

![Figure 6. The initial appearance of the application articulate and support for android with the .apk format.](image1)

![Figure 7. Display after entering the comic image.](image2)

3.5. Display android

![Figure 8. Android initial display.](image3)

![Figure 9. Display material on android.](image4)

This research and development aims to produce digital-based science comics with simple aircraft materials and determine the feasibility of digital-based science comics with simple aircraft materials for elementary school grade IV science content.

The results of the validation of digital-based science comics have been validated by three validators, namely two lecturers and one teacher. The two lecturers are Ms. Nuhyal Ulia M.Pd. and Mr. Jupriyanto, M.Pd. and one teacher, Mrs. Azizah, S.Pd.SD. The results of the validation obtained an average of 3.78 of the maximum average value of 5 including the Valid category.

Practicality is taken from questionnaire responses from teachers and students on large-scale trials. From the results of the questionnaire obtained an average score of teacher questionnaire responses 3.82 of the maximum average value of 5 with good criteria, while for the questionnaire student responses obtained an average of 3.68 of the maximum average value of 5 with a good category.

4. Conclusions

Technology can support and support the effectiveness of learning. With the use of technology that is currently developing in a positive direction, it is certainly able to minimize the negative impacts of the rapid development of technology. Here the teacher's role is very necessary in exploiting the potential of digitalization with the ability to innovate and be as creative as possible to create a learning medium that develops according to the times. One way to make learning more interesting and not get bored quickly with the use of technology is to develop digital-based comics. Learning media that use the application articulate and support for Android with the .apk format.
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