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Article

FOSIL (Flood Simulation in Glass): An Integrated Science Learning Media with 3D Digital Animation Plotagon

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ABSTRACT

Global digitization encourages the education system to produce quality human resources through a learning process that is integrated with technology, namely learning media. FOSIL learning media is present to help improve students' understanding of natural disasters and their mitigation by combining the concepts of religion, physics, chemistry and biology and linking with 3D plotagon animation. The purpose of this research is to describe the feasibility of the developed FOSIL learning media. This research method is development research (R&D), using the ADDIE design model with stages: analysis, design, development, implementation, and evaluation. The data collection method is by requesting validation from 3 validators based on stratified random sampling. The validation results were analyzed using descriptive statistical techniques by determining the average value of feasibility based on the assessment indicators of the 3 validators and developed into a description. Based on the data analysis of the validation results, the average percentage of feasibility is 82%, so FOSIL is feasible to use in learning about flood disasters and their mitigation. FOSIL has the potential to improve the quality of learning, especially in terms of understanding the concepts and skills of students and can be a reference for developing more effective learning models

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INTRODUCTION

In the era of digital globalization, education is one of the sectors that has undergone major changes. Technology has opened up new opportunities, but on the other hand, new challenges have also emerged. This requires all institutions, from the government, entrepreneurs, educators to students, to be able to adapt quickly. The challenges faced by the world of education in the era of globalization include; The gap in access to technology, the digital divide refers to the difference in access to affordable and stable internet access to technological devices, such as computers, laptops or mobile phones. Although technological advances allow for wider access to information, the digital divide between urban and rural areas is still a problem. This can be seen from the fact that there are still inadequate schools that cause the school to lag behind other schools. For example, schools in urban areas are usually more

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advanced in terms of technology and facilities and infrastructure compared to schools in rural areas (Butsan, 2022).

The next challenge is related to the quality of education that meets global standards. With globalization there is a push to ensure that the local education system can compete globally. This means that the curriculum must be able to produce graduates who have critical, creative, and adaptive thinking skills in accordance with the needs of the global market. However, the application of global standards often clashes with local conditions, such as inadequate infrastructure or the availability of qualified teachers. To be able to compete in 21st Century Skills Development Education in the era of globalization is needed which not only focuses on academic knowledge, but also 21st century skills such as communication, collaboration, creativity, and critical thinking skills. This challenge involves changing teaching methods to be more interactive and collaborative, shifting the focus from memorization to problem-solving and character development.

In Indonesia itself, the purpose of education refers to article 3 of the national education system law number 20 of 2003, namely: the development of students to become human beings who believe in and devote themselves to God Almighty, have noble character, are healthy, knowledgeable, capable, creative, independent and become democratic and responsible citizens. This emphasizes the balance between knowledge, character, and spiritual aspects in shaping the nation's next generation.

In the midst of globalization, education in Indonesia aims to equip students with 21st century skills such as critical thinking, creativity, and the ability to adapt to technology. Students are expected to be able to face rapid changes in the world of work and global society, as well as use technology wisely to maximize their potential. In addition, education also has an important role in maintaining and strengthening cultural identity. With strong moral and cultural values, the young generation is expected not only to be open to global culture and knowledge, but also to still appreciate and preserve local and national values.

By combining good character, modern skills, and strong cultural identity, national education is expected to be able to produce a competitive generation at the global level. They will become individuals who are not only personally successful, but also able to contribute to building a better society and nation.

The National Education System Law states that education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble morals, and skills needed by themselves, society, nation and state. Based on the Law, education is aimed at training and developing the skills possessed by students. Skill development is trained by an educator to students through the learning process. Referring to the independent curriculum, the learning system is carried out in a differentiated manner. The process of differentiating lessons is carried out to answer the needs, styles, or learning interests of each student (Untari, 2023).

Skills development is carried out through intracurricular, co-curricular and extracurricular (Muslim, 2021). This is in line with Permendikbudristek No. 12 of 2024 article 7 which states that intracurricular, co-curricular and extracurricular activities are part of the curriculum structure. So that these three activities must be managed by each educational unit. The skills gained during the learning process can be a provision for students to face the changing times. Therefore, a teacher must think creatively and innovatively so that learning can be more meaningful for students.

The activeness of students in learning is the forerunner of the success of the learning process, therefore learning must be designed in such a way that it becomes interactive learning. The interactive learning method is a learning technique or a method that teachers can use in delivering material, by involving their students to be actively involved. This learning method

also inserts an element of active learning in it because students are involved in activities, such as reading, writing, discussion, or problem-solving that integrate analysis, synthesis, and classroom evaluation in the teaching and learning process (Cosner, 2020; Aminatul., *et all*, 2022). With the development of the times, it encourages the world of education to integrate and utilize technology and information into it. The use of technology in the world of education refers to several aspects, including various *e-learning platforms*, the development of learning media, and the national education system (Hodayatullah., *et al*, 2023). This is where the role of teachers to make learning more meaningful, namely by utilizing technology in the learning process with the goal that students have a high interest in learning.

The use of learning media in the teaching and learning process can arouse new interests and desires, generate motivation and stimulation of learning activities, and even bring psychological influences to learning (Makaborang, 2023). Learning media is one of the important components in achieving success in the learning process. The media has a very important role, namely as a means of communication to convey the message that students must achieve in learning activities (Rahmawati & Asyriah, 2023). The learning media used to support the learning process are usually in the form of multimedia and 3D media.

Multimedia is a cutting-edge technology product that is digital and is able to provide a rich learning experience with various creativity (Sholehah., et all, 2023). Multimedia is the incorporation of media elements that include images, videos, sounds and others that are assembled into a complete combination. One of the multimedia that is often used in learning is 3D animation videos to convey information. An animated video is a moving image that comes from a collection of various objects that have been specially arranged so that they move according to a predetermined flow (Farida., et all, 2020). One of the 3D animation creation service provider platforms is plotagon. Meanwhile, 3D media can be used to help students understand abstract material, because 3D media can show that an object that is still abstract, into a concrete object (Rahmawati & Asyriah, 2023). An example of 3D media for learning is simulation media about natural phenomena that often occur in the surrounding environment.

Natural phenomena that often occur and become polemics are natural disasters and their mitigation, especially flood disasters. Natural disasters and their mitigation are one of the materials studied at the junior high school level in science subjects. Natural disaster materials are abstract materials in the classroom, so media is needed as a means of facilitating the delivery of information about the causes, impacts and mitigation of flood disasters. The purpose of this study is to describe the feasibility of the developed FOSIL learning media.

METHODS

Based on the formulation of the problem, the type of research used in this study is development research (R&D), where this method aims to produce products obtained from the discovery of potential problems, design and develop a product, (Marinu, 2024). The product being developed in this study is a learning medium that combines simulation tools and 3D animation (plotagon) using the ADDIE development model with stages: using the ADDIE design model with the stages: *Analysis*, *Design*, *Development*, implementation and *evaluation of* the final product, (Indah Melisa, et al. 2019). The data collection method is by requesting validation on 3 validators based on stratified random sampling.

RESULTS AND DISCUSSION

1. FOSIL Learning Media

FOSIL learning media is a learning medium to simulate flood disasters as well as explain solutions to problems. FOSIL stands for Flood Simulation in Glass which is inspired by the appearance of media in an aquarium. In its development, it requires stages including needs analysis, design and media making. Each stage will be explained as follows.

a. Needs analysis

Natural disasters are conditions where natural phenomena change due to human actions or come from nature itself. Natural disasters bring many negative impacts that affect the physical and mental effects of the affected victims. To reduce the magnitude of these negative impacts, efforts are needed to provide experience and knowledge with the aim of saving themselves when a disaster occurs. One way to provide knowledge is through education, in line with Permendikbud No. 33 of 2019 concerning the Implementation of the Disaster Safe Education Unit Program. One of the objectives of the SPAB program is to train competent resources in educational units as an effort to prevent and reduce disaster risks.

One of the natural disasters that is currently a polemic is the flood disaster. Flooding is an event of abundant water that overflows to the land, which is usually dry, due to high rainfall, snowmelt, or other problems that result in water not being absorbed quickly by the ground or drained by existing waterways (Dino, 2023). Floods can be caused by human actions or come from nature and floods often hit densely populated areas with inadequate water catchment areas, so that water overflows into populated land. In addition, high rainfall causes water discharge to increase, if the river that is the flow of water is clogged by garbage, it can hinder the flow of water and flood occurs.

The concept of flood disaster and its mitigation is relatively abstract when taught to students at the junior high school level. To make it easier to learn about floods and their mitigation, media is needed that can show a real picture of the disaster events that occurred. Media is something that channels messages and can stimulate the mind, feelings, and will of children (students) so that it can encourage the learning process in them (Nabila., et all, 2019). Disaster education learning requires the right selection of media to support student material, the correct selection of media makes it easier for students to understand disaster material (Wiluyana., et al, 2024).

Based on the above analysis, the development of FOSIL learning media is present. This learning media has the advantage of being interactive by involving students during the learning process. In addition, the presentation of material carried out with direct instruction makes learning more meaningful.

b. Planning

The design stage involves depicting the design from the FOSIL learning media and collecting tools and materials. Each of the two steps is explained as follows.

1) Design depiction

The FOSIL learning media is intended to simulate the process of flooding and its mitigation. To display FOSIL learning media, components are needed that compose this media. These components are made using simple materials or used materials that are still suitable for use, so that anyone can make them easily. The components needed consist of the following things.

a) Container components, containers used using aquariums that are no longer in use but are still suitable for use with no damage to the aquarium. The aquarium was obtained by buying it from one of the friends who owns a used aquarium. The choice of the aquarium to be a container is because it is more durable than using a plastic container and the characteristics of the aquarium are transparent, making it easier for students to observe from all directions.

b) Flood components, floods can occur due to the flow of flowing water. The components for draining water are bottles, hoses and supports. The bottles used are used drink bottles that have been cleaned in two different sizes, namely small and large. Small bottles are placed in an aquarium glued with sterofoam so that they do not come off and remain floating. The sterofoam also serves as a barrier

wall to prevent water from pooling at the bottom of the small bottle. At the bottom of the small bottle is perforated and connected with a short hose as an outlet for water. While large bottles are used to be a source of water that flows as if from a source. Large bottles and small bottles are connected by hoses to deliver water. Large bottles are placed outside the aquarium in a higher position than small bottles to help the water flow. Bottle twelve is glued to a wooden support so that it does not come off and fall off. The supports and aquarium are glued together to facilitate removal.

c) The components of the land plot, the material used is used sterofoam which still has good quality. The characteristics of the sterofoam used are thick and light. The choice of sterofoam is due to its waterproof and lightweight nature. In addition, sterofoam is easy to use as a foothold for the decoration used. Sterofoam is glued in the aquarium with a slightly inclined position to help the water flow. Sterofoam is perforated in the middle at both ends for water passage and air circulation. In the middle is carved a flow for the water to go to one of the holes, where the hole has been placed a sheet of cloth to filter small objects. On the right and left of the stream are drilled as many as six holes as a place for plants to grow.

d) Biological components, because the learning media that is made integrates various concepts, one of which is the existence of ecosystems, the existence of biology in this media is very important. The biological components used are fish and plants in the form of shallots. The fish is placed under sterofoam and the onion is placed in the sterofoam holes.

e) Complementary components, supporting elements in the form of miniature buildings and miniature trees. The miniature building is made from printed out images of buildings pasted on sterofoam. Meanwhile, miniature trees are made with sterofoam which is measured and colored according to the shape of the tree. The two miniatures are attached to the main sterofoam using a toothpick.

2) Collection of tools and materials

In making a simulated 3D learning media, supporting tools and materials are needed, so that the learning media made seems realistic and applicable. The collection of tools and materials is adjusted to the design that has been made. This design provides an overview of the actions and needs needed. Based on the design above, to make FOSIL learning media, tools and materials are needed, namely pencils/ballpoint pens, rulers, hammers, cutters, glue, tape, toothpicks, crayon dyes, wooden boards, nails, pieces of fabric, sterofoam, aquariums, bottles (large and small), hoses, water and biological components.

c. Manufacture

The manufacturing stage is carried out based on the design made at the beginning, paying attention to the suitability of the ratio and realistic depiction. The manufacturing stage includes several actions in it, namely the preparation of each component, the unification of all components and trials. The three actions are explained as follows.

1) Preparation of each component

Sterofoam is cut into pieces and carved according to the size of the aquarium. The main sterofoam at each middle end is perforated as a water outlet by attaching a piece of fabric as a filter and air circulation. Then the top is carved with a river as a waterway and on the left and right sides there are 6 holes as a place to grow shallots. The main sterofoam is dyed to beautify the look with crayons. On another sterofoam, a miniature tree is carved and a miniature building is pasted with pictures of buildings using tape. Each miniature is pierced with a toothpick to

balance when placed on the main sterofoam. In sterofoam, on the other hand, it is cut to form a dam to glue small bottles and a hole is made at the bottom as water flows. This sterofoam is cut according to the width of the aquarium and is colored black.

To create a stream of water, the first is to punch small holes in the bottles on both opposite sides. The bottle is perforated at the top for water entry from the large bottle with a hose and the bottom for water to exit by inserting a hose. In the large bottle, a hole is made at the bottom to channel water into the small bottle using a hose. Each part of the bottle is glued together, to which each hole is connected by a hose.

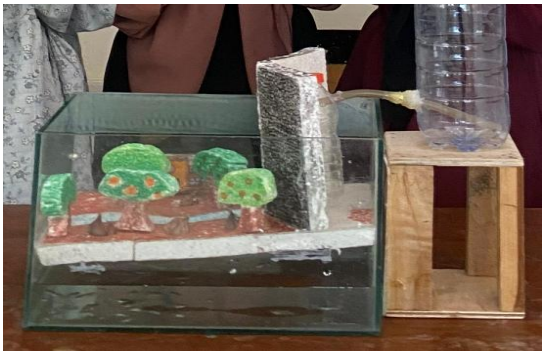
For the support use wooden boards cut and nailed to form a tower. The bottom of the large bottle is glued to the support. This aims to make the large bottle higher than the small bottle, so that the water can flow down.

2) Unification of all components

Starting with gluing the main sterofoam in the aquarium, the position of the sterofoam is in the middle of the aquarium with a slightly tilted condition to facilitate the flow of water. Sterofoam is glued with glue on each side so that it is stronger and does not float. In this process, it must be ensured that each side is closed so that there is no gap for water to seep down. Then the sterofoam that is used as a dam is glued to the opposite side of the water estuary, this dam aims to be a place for small bottles to stick and a barrier for water to flow into the air circulation hole. Small bottles are glued to the dam with a hose through the bottom hole of the dam that is parallel to the river flow. Meanwhile, the support that has been attached to the large bottle is glued to the side that is parallel to the small bottle and is outside the aquarium. Finally put water in the aquarium through the circulation hole and put small fish together and install the miniature and onion on top of the main sterofoam.

3) Trial

The operation of the fosil learning media by filling a small bottle with water in 3 out of 4 parts by clogging the water flow hose so that it does not flow out. Then fill a large bottle with water to the brim and the stopper is removed. To test the condition during flooding, the water estuary part is plugged with sterofoam which acts as garbage. The clogged water flow makes the river overflow and floods. In this condition, it is necessary to ensure that there is no gap for the water to go down. If there is a gap, it is plugged with adhesive.



Picture 1. Figure of FOSIL Learning Media

2. Plotagon Design

In making plotagon animations, what we need to do is to create Bord stories and story lines, as well as plotagon applications. The illustration design used is:

Picture 2. Figure of Plotagon Video Design

Picture 3. Barcode Link for Plotagon Video

The first step to create an animation using Plotagon is to download the Plotagon app from the App Store (iOS) or Google Play. second, Open the Plotagon app and select the option to create a new project. Third, choose a setting that suits the story we want to create. Fourth, choose the character who will play a role in the animation and adjust the character's appearance by changing skin color, hair, clothes, and facial expressions. Fifth, write dialogue for each character and different voice content for each character. Sixth, Plotagon will automatically move the character's lips according to the dialogue. Seventh, set up the sound and background music that makes the animation more lively. Eighth, set the camera's angle of view to get an attractive view. Such as zooming in, zooming out, or rotating the camera. Ninth, previewing the animation is like replaying the animation to see the result. Finally, save and share the animation to social media or other video platforms.

The working step of the animation that we made is after the finished video is uploaded to you tube or other social media, then the link from you tube is converted into a QR code after which the QR code is listed on the fosil learning media.

For the animation results that we made, you can scan the QR code that has been included on the fosil learning media.

3. Validation Results

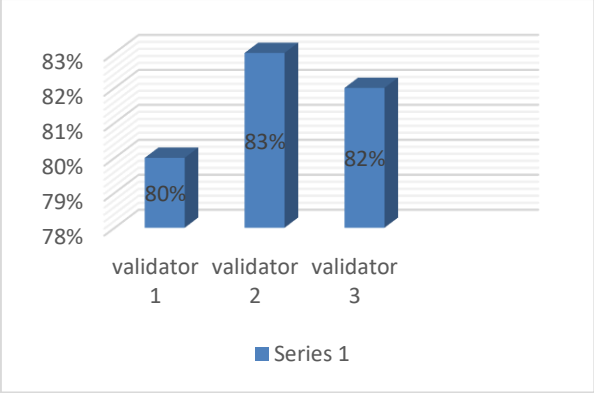


Figure 3. FOSIL Validation Results Chart

The feasibility of Learning Media based on the analysis of 3 expert validators obtained an average percentage of feasibility of 82%. From these results, it can be concluded that FOSIL learning media is suitable for use in science learning to understand the concept of flood disasters and their mitigation. The use of disaster simulation media has the potential to improve the quality of learning about disaster materials and their mitigation, especially in terms of understanding the concepts and skills of students. FOSIL learning media can also be a reference in the development of a more effective learning model by integrating disaster simulation media as a central element. As a form of integration, in addition to explaining disaster materials and their mitigation, FOSIL learning media can also be used as a learning medium to explain the concepts of dynamic fluid materials, ecosystems, and light refraction.

Of the several advantages contained, of course, FOSIL learning media is not spared from its shortcomings. The shortcomings/suggestions of the FOSIL learning media are based on the results of the analysis carried out by 3 expert validators as follows:

Validator 1: Building props can be replaced with more durable materials such as small boxed wood.

Validator 2: Less explanation of the concept of light refraction. Maybe you can add props related to the concept above. Or you can add a picture/description of the light refraction that occurs.

Validator 3: Drawing/coloring can be made even more interesting, it is better to use polluted water so that the effect on the fish is visible, and the relationship between how the media works and the light habituation material is not so visible.

With the shortcomings in the learning media that have been made, the author plans to develop FOSIL learning media based on the suggestions that have been given by the Validator.

4. Value

Science learning media "FOSIL" which combines flood disaster simulations and digital animation videos can help teachers and students in carrying out learning activities. FOSIL integrates various concepts, including the concept of flood disasters and their mitigation, the concept of ecosystems, the concept of hydrostatics, and the concept of light refraction. By combining several of these concepts in one learning medium, the learning time will be more effective and teachers do not need to prepare many different learning media for each concept.

Interactive simulations applied in FOSIL can make it easier for students to understand concepts because students can be actively involved directly in the process. The combination of visualization, simulation, and digital elements allows students with visual, auditory, and kinesthetic learning styles to be optimally involved in the learning process. Thus, FOSIL media can provide a meaningful learning experience for every student.

Digital animations that have interesting visualizations in FOSIL learning media can attract students' interest and motivation to learn them. The coherent storyline and vivid animations can create a fun and meaningful learning experience. The use of simple and contextual language and situations relevant to daily life make it easier for students to build connections between learning materials and the real world.

CONCLUSION

The conclusion of the article is that the development of FOSIL (Flood Simulation in Glass) learning media that integrates flood disaster simulation and digital animation is very effective in increasing students' understanding of natural disaster materials and their mitigation. This medium not only provides an interactive and enjoyable learning experience, but also incorporates various important concepts such as ecosystems, hydrostatics, and light refraction.

One of the key elements in the development of FOSIL was the use of digital animation created with the Plotagon application. These animations allow for the depiction of compelling stories with customizable characters, dynamic dialogue, and relevant settings. The animation creation process includes writing dialogue, setting sounds, and setting the camera angle of view, so as to produce an attractive display and support student understanding.

The validation results show that this media is feasible to use with a feasibility percentage of 82%. Nonetheless, there are some suggestions for improvement, such as the use of more durable materials for miniature buildings and the addition of elements that explain the concept of light refraction. By utilizing this media, learning can be more effective and comprehensive, so that students can actively engage and understand the material better.

AKNOWLEDGMENT

Innovation of learning media about flood disasters and their mitigation requires further development to be more effective in increasing students' understanding of the impact and measures to overcome the disaster. This development can involve improvements in the presentation of materials, increased interactivity, and adjustments to the needs and characteristics of students. In addition, research conducted in the classroom is also needed to test the effectiveness of this learning media in increasing students' knowledge and awareness of flood disaster mitigation. This research can involve testing learning media, observing the learning process, and measuring student learning outcomes before and after using the media, so that it can be known whether this innovation is really able to have a positive impact on student understanding

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