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Development of Mini Virtual Aquatic Ecosystem Learning Media Assisted by Professional 3D Pageflip Software

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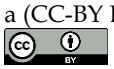

Abstract: This development aims to produce a mini virtual learning media product for aquatic ecosystems assisted by professional 3D pageflip software. The development research model used is the Four-D (4D) model, which consists of 4 stages including: (1) define stage, (2) design stage, (3) develop stage, practicality testing is carried out. , and the dissemination stage was not carried out due to time constraints. The trial subjects in this research involved 36 students of SMAN 9 Mataram class X1, and involved teachers as user practitioners and observers to assess the implementation of learning. The data collection techniques used consisted of learning implementation questionnaire sheets, teacher response questionnaire sheets and student responses. The data analysis used is quantitative and qualitative. Based on the results of the practicality test, it can be concluded that the virtual aquatic ecosystem mini media is very practical to use. The teacher's response showed a percentage of 89.32 in the very practical category, and the student response showed a percentage of 86.04 in the very practical category. Meanwhile, learning implementation is 90%, and non-implementation is 10%.

Keywords: Mini aquatic ecosystem; Professional 3D pageflip software; Virtual learning media

Introduction

Progress in the field of educational technology demands the role of teachers in managing information and the learning environment, one aspect of which is enriching learning resources and media (Rosikin et al., 2021). Learning media is not only a communication tool between teachers and students, but must also meet competency standards while being able to attract students' attention to be used effectively (Mukarromah et al., 2022). The availability of learning media plays an important role in supporting effective learning (Hafzah et al., 2020; Yuliani H et al., 2017). This media plays a role in optimizing students' learning experiences by presenting material in a more interesting and easy to understand way for students (Pratiwi et al., 2018).

The availability of media in the biology learning process is currently still limited (Arifin et al., 2023; Nevrita et al., 2020), especially related to concepts that require in-depth understanding such as ecosystem material. Making learning media about ecosystem material has special challenges because it requires accurate presentation in real context (Sholihah et al., 2020). Ecosystems are complex systems that involve interactions between living organisms and environmental factors in their natural environment (Husain et al., 2019). Therefore, in making ecosystem media, it is important to pay attention to small details that reflect the actual condition of the ecosystem, one of which is through aquascape media (mini ecosystem).

Aquascape media (mini ecosystem) is an art that involves the aesthetic arrangement of water plants, rocks and wood in an aquarium (Setyadi, 2014). Aquascape media offers significant advantages in supporting independent learning by providing guidance that allows students to observe objects directly and develop their own understanding (M. Pratiwi, 2017). Aquascape media is not only a decorative activity, but also a medium for teaching scientific and ecological concepts to students. Aquascape can also create learning that

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allows students to become active and independent learning centers, as well as more meaningful learning experiences (Setyadi, 2014; Surata et al., 2020).

Bringing the actual ecosystem concept into the classroom learning process requires the development of virtual aquascape (aquatic ecosystem) media. This media allows students to explore and understand various aspects of aquatic ecosystems without having to physically interact with the natural environment (Ramadhila et al., 2022). With virtual media, students can view and manipulate ecosystem elements, observe interactions between living organisms and environmental factors, and carry out experiments and simulations without risk to the real environment. The use of interactive virtual aquatic ecosystem media not only expands accessibility to aquatic ecosystem learning, but also provides a deep and memorable learning experience for students, thereby helping them understand ecosystem concepts well interactively (Laksono et al., 2022).

The advantage of interactive learning media is that it can facilitate active two-way communication between teachers and students, with the aim of facilitating the learning process (Gunawan et al., 2017). The development of virtual aquatic ecosystem media can be done with one of the software tools that can support the development of creative media, namely 3D pageflip professional. 3D Pageflip Professional software is a computer application specifically designed to create flipbooks with 3D effects in an interactive format (Kurniawan et al., 2021). This provides users with a more realistic experience when turning pages in digital modules and e-books (Hull et al., 2006). This software is an application that can convert PDFs into digital flipbooks, allowing developers to create interactive learning content with various supporting features. One of them is the ability of the display to be reversed when reading it (Aftiani et al., 2021; Diani et al., 2018).

3D Pageflip Professional software is an interactive tool that allows users to easily add various types of animated media into flipbooks via drag-and-drop or click features, including the ability to insert YouTube videos, hyperlinks, animated text, images, audio, and flash (Lestari et al., 2023). The advantages of this software include: 1) Interactive publishing, with an attractive appearance, and can add videos, images, links, which makes the flipbook interactive with users; 2) There is a wide variety of templates, themes, scenes, backgrounds, and plugins; 3) E-books can be supported with text and audio; 4) Flexible output formats, such as html, exe, zip, mobile version, burn to CD, and easy to operate on laptops and mobile devices (Febrianti, 2021; Ferdianto et al., 2019).

Based on the description above, the aim of this research is to develop a mini virtual learning media for aquatic ecosystems with the help of 3D Pageflip Professional Software in order to support technology-based 21st century learning.

Method

The type of research used is R & D (Research and Development) research with a 4D development design (Thiagarajan, 1974). In designing this mini aquatic ecosystem media with a 4D model, there are 4 stages in its preparation, namely define, design, develop and disseminate. At the define stage, front end analysis, student analysis, concept analysis, task analysis and learning objective specifications are carried out. At the design stage, the preparation and creation of mini aquatic ecosystem media is carried out. At the develop stage, media that has been declared valid by experts is then tested for practicality. At the dissemination stage, product distribution was carried out widely, but in this research it was not carried out and was carried out only through practical tests due to time constraints.

The practicality test aims to obtain direct input in the form of responses from students and teachers regarding the mini aquatic ecosystem media being developed. The practicality test was carried out on a group of students as respondents. Mahmud (2011) stated that the minimum number for practical trials is 30 students as a sample. The trial subjects in this research involved 36 students of SMAN 9 Mataram class X1, and involved teachers as user practitioners and observers to assess the implementation of learning. The data collection techniques used consisted of learning implementation questionnaire sheets, teacher response questionnaire sheets and student responses. Guidelines for scoring questionnaires use a Likert scale of 1 to 5, with a score of very poor (1 value), poor (2 value), sufficient (3 value), good (4 value), and very good (5 value). The results of the teacher response questionnaire are used as a reference for the practicality of the product being developed.

Analysis of the practicality test data from teacher response questionnaires and student responses to the mini aquatic ecosystem media that has been developed is analyzed using the following formula:

$$\frac{S}{N}P_{(k)} = \quad x\ 100\ \% \tag{1}$$

Information:

$P_{(k)}$ = Component percentage
S = Total score obtained
N = Maximum total score

After analysis, the results of the learning implementation questionnaire, teacher responses, and

student responses were interpreted according to the practicality criteria in Table 1 as follows:

Table 1. Practicality Criteria (Daryanto, 2016)

Practicality Percentage (%)	Practicality Level
≥ 81	Very practical
61 - 80	Practical
41 - 60	Quite practical
21 - 40	Less practical
≤ 20	Not practical

Result and Discussion

Define Stage Results

The define stage consists of 5 stages, namely: (a) front end analysis; (b) student analysis; (c) task analysis; (d) concept analysis; and (e) specification of learning objectives.

Front end analysis consists of two analyses, namely teacher needs analysis and student needs analysis. This analysis involved Biology teachers and 36 students of SMAN 9 Mataram. The results of the analysis of teacher needs and analysis of student needs through observation sheets revealed problems related to the limited use of learning media, especially ecosystem material, which so far has been limited to the use of LKPD with assignments to observe the environmental ecosystem around the school, so the use of learning media is still limited, especially those based on technology. . Based on these problems, it is necessary to develop virtual aquatic ecosystem mini media with the help of 3D Pageflip Professional Software.

The analysis of students consists of two analyses, namely analysis of characteristics and analysis of students' learning motivation. In the analysis of student characteristics, an analysis of students' understanding of ecosystem material was carried out, based on cognitive data from the teacher.

Task analysis is carried out using an observation sheet on the devices used by the teacher, by analyzing the suitability of the assignment given to the learning objectives to be achieved. Concept analysis is carried out by describing indicators of competency achievement in accordance with the selected Learning Outcomes, and developing concepts for material that will be included in interactive multimedia products. The final stage of define is the elaboration of learning objectives or specification of learning objectives.

Results of the Design Stage

At the design stage there are four stages, namely: (a) selecting and compiling the mini aquatic ecosystem media format, (b) systematic preparation of ecosystem material, (c) programming the mini aquatic ecosystem media using 3D Pageflip Professional software and (d) Preparing test instruments practicality and learning tools. The initial stage of making mini aquatic ecosystem media is to record the process of making the media (Figure 1).

Figure 1. Making media process

The tools and materials needed for a mini aquatic ecosystem media are a medium aquarium/large clear jar, plain water, cold water/ice cubes, warm water, pebbles, Hydrilla verticillata plants, Tilapia nilotica fish, study lamp/cellphone lamp, substrate components supporting the contents of a mini water ecosystem, a hot plate, a beaker or container for heating water, and a basin for holding ice cubes.

The procedure for making a mini aquatic ecosystem is: (a) Preparation of materials and tools: first prepare a medium sized aquarium, Hydrilla verticillata plants, Tilapia nilotica fish, small gravel/beach stones, sand, and/or other substrates, as well as clean water that is not contains chlorine. (b) Arranging the components in the aquarium: Put sand or substrate into the bottom of the aquarium, then arrange the rocks to form an attractive landscape, then insert the Hydrilla verticillata plant into the substrate or place it separately in the aquarium. (c) Adding water: carefully pour water into the aquarium until it reaches the desired level (water conditioned according to experimental treatment). (d) Biota integration: add live biota such as starfish, snails, or other biotic components to form a more complex ecosystem, and pay attention to the amount and type of biota added to suit the capacity of the aquarium.

The topic of ecosystem material has several sub-topics such as biotic and abiotic ecosystem components, interactions between biotic and abiotic components, as well as discussing types of ecosystems (land and aquatic). In this research, media will be developed that can be used for this sub-material, namely aquatic ecosystem mini media. There are six treatments used in making mini aquatic ecosystem media, with the aim of seeing the comparison of the influence of abiotic components (light and water temperature) on biotic components (Hydrilla verticillata plants and Tilapia nilotica fish).

The conditions for using the treatment are based on the concept that the water ecosystem of the Hydrilla verticillata plant can be used as a bioindicator for a water ecosystem that is still maintained. Apart from that, the Hydrilla verticillata plant can produce oxygen with indicators of the presence of air bubbles. In an ecosystem, abiotic components such as light and temperature can influence biotic components. For example, in a water ecosystem/river ecosystem, light intensity can affect the air bubbles (oxygen) produced by the Hydrilla verticillata plant. Temperature is also a factor that can influence the biotic components in an ecosystem. In a water ecosystem/river ecosystem, different temperature intensities can affect biotic components such as fish. The fish will adapt to differences in environmental temperature, which is indicated by the slow opening of the goldfish overculum. At cold temperatures, the overculum will open and close more quickly, and at hot temperatures the overculum will open and close more slowly. The four treatments used are as follows:

Table 2. Treatment of Virtual Ecosystem Mini Media

Treatment	Description
I	Mini water ecosystem with normal treatment/ no treatment
II	Mini aquatic ecosystem with high light intensity
III	Mini water ecosystem with the addition of cold water (cold temperature)
IV	Mini water ecosystem with the addition of warm water (warm temperature)

The mini aquatic ecosystem media that has been created and videoed is then used with the help of 3D Pageflip Professional software so that it can be accessed virtually (Figure 2).

Figure 2. Results of making mini aquatic ecosystem media using 3D pageflip professional software

Develop Stage Results (Practicality Test)

At this stage, a test of the practicality of virtual aquatic ecosystem mini media was carried out with 36 class X1 students at SMAN 9 Mataram as test subjects. The results of the teacher response questionnaire and student responses to the virtual mini media of aquatic ecosystems can be seen in tables 3 and 4.

Table 3 shows the average teacher responses for aspects that are considered to be in the very practical category. The aspects evaluated include teaching modules, learning materials, virtual aquatic ecosystem mini media, test instruments and questionnaire instruments. Teaching modules, learning materials and test instruments each obtained a percentage of 86.66, which shows that these three aspects are considered very practical by the teacher. Meanwhile, mini aquatic ecosystem media and questionnaire instruments got a higher percentage, namely 93.33, which is also included in the very practical category. Overall, the average percentage of all aspects assessed was 89.32, confirming that teachers felt that all aspects were very practical in supporting learning activities.

Table 3. Teacher Response Results

Aspect	Percentage (%)	Category
Teaching module	86.66	Very practical
Learning materials	86.66	Very practical
Virtual ecosystem mini media	93.33	Very practical
Test instrument	86.66	Very practical
Questionnaire instrument	93.33	Very practical
Average	89.32	Very practical

Table 4 shows the average student responses for all aspects that were assessed as being in the very practical category. The learning activity aspect obtained a percentage of 82.91, indicating that students felt the learning activities provided were very practical. Learning Material got a higher percentage, namely 89.16, indicating very high satisfaction with the material taught. The mini ecosystem media was also considered very practical by students with a percentage of 85%. Overall, the average percentage of all aspects assessed is 86.04%, which confirms that students feel very helped and satisfied with the learning activities, learning materials and mini ecosystem media used in the learning process.

Table 4. Students Response Result

Aspect	Percentage (%)	Category
Learning activity	82.91	Very practical
Learning Material	89.16	Very practical
Mini Ecosystem Media	85.00	Very practical
Average	86.04	Very practical

The use of virtual aquatic ecosystem mini media in learning has advantages that can improve the quality of learning. This media allows students to study ecosystems interactively and realistically without having to be in the field. With digital simulations that display various organisms and their interactions in an aquatic environment, students can directly observe how the ecosystem functions. This helps them understand ecosystem concepts, such as biotic and abiotic components, as well as the interactions between these components. The learning process becomes more meaningful because students can connect new information with the knowledge they already have, which can help strengthen students' understanding. Thus, the use of a mini virtual aquatic ecosystem not only makes learning more interesting, but also more effective in building deep and meaningful knowledge (Taupik et al., 2023).

Apart from that, the use of technology in creating meaningful learning through mini virtual ecosystem media can provide various advantages. Technology makes it possible to create very realistic and interactive ecosystem simulations, where students can actively participate in the learning process (Widianto, 2021). In addition, technology allows wider access to educational resources that may previously have been difficult to reach (Sari et al., 2016). The use of technology in learning also makes it possible to make material more interesting and easy to understand, and learning to be more adaptive, interactive and fun, thereby creating a more meaningful and memorable learning experience for students. This is in line with the results of learning implementation with a percentage of 90% (Table 5).

Table 5. Learning Implementation Results

Activity	Accomplished (%)	Not Accomplished (%)
Introduction	15	5
Content	55	5
Conclusion	20	0
Total	90	10

The results of learning implementation shown in Table 5 illustrate that learning using virtual ecosystem mini media was overall successfully implemented well, with 90% of activities carried out and only 10% not carried out. In the preliminary stage, implementation reached 15%, which indicates that this media is able to attract students' attention from the start of learning. At the core stage, implementation reached 55% indicating that the use of a virtual mini ecosystem was effective in helping students understand the main learning material. This may be due to the interactive and visual nature of the media which is able to clarify the ecosystem concept in a more concrete and interesting way.

In the closing stage, implementation reached 20%, which reflects success in summarizing and closing the learning well, ensuring that students can reflect and consolidate their understanding. Overall, the use of virtual ecosystem mini learning media contributes positively to the high level of learning implementation, helping to create a more interactive and effective learning environment. In line with Inayah et al. (2021) stated that the use of virtual simulations in science learning improves student learning outcomes because it is able to provide a more concrete and contextual learning experience.

Conclusion

Based on the results of the practicality test, it can be concluded that the virtual aquatic ecosystem mini media is very practical to use. The teacher's response showed a percentage of 89.32 in the very practical category, and the student response showed a percentage of 86.04 in the very practical category. Meanwhile, learning implementation is 90%, and non-implementation is 10%. The suggestion that researchers recommend is that it is necessary to carry out effectiveness tests on a wider scale.

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The authors declare no conflict of interest.

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