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Innovation in Science Learning Using Augmented Reality in Animal Metamorphosis Materials

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A B S T R A C T

Currently, there are still many science lessons that use the lecture method and are teacher-centred. There are still many students' natural science scores whose grades are below the KKM; the cause of low grades in this era is monotonous and unpleasant learning. Teacher-centred learning also makes students easily bored and bored, so they are not interested in learning related to the material being presented. Regarding this problem, the authors created a learning media in the form of an augmented reality application that functions to help students get to know and interact in real-time about Natural Sciences subjects, especially on animal metamorphosis material. The author uses the Multimedia Development Life Cycle (MDLC) development model through six stages, namely concept, design, collecting, assembly, testing, and distribution. From the results of making this application, animal metamorphosis learning will be easily recognized through augmented reality media, and students can enthusiastically learn using this application. Therefore, it is essential to make this learning media because students will be interested in learning new things, primarily related to 3D from augmented reality. Moreover, this technology is still rarely encountered and used in learning today.

1. INTRODUCTION

The low value of science learning is closely related to the gap between science learning implemented in schools and the demands of the Program for International Student Assessment (PISA), where currently there are still many schools where the application of science learning is still teacher-centered, using the lecture method to convey materials and utilizing makeshift teaching aids as learning media, so that the application is not maximized (Kusumah et al., 2020).

From several surveys that have been conducted, it is known that out of 100%, only 16.7% of students can meet the completeness criteria. This shows that almost half of all students do not complete their studies or score below the specified KKM, namely 70 (Taonah, 2016). Students consider that science subjects are not fun, these subjects are considered full of memorization and boring formulas and the use of media and learning methods that are less innovative, resulting in students being lazy to learn and students' interest in learning science subjects reduced (Didik et al., 2019).

Science learning is critical in conducting investigations by integrating the skills, knowledge, and attitudes used to understand the basics of learning science. Science learning also emphasizes providing direct experience to develop competence in students so they can understand the natural world around them. Science subjects aim to teach students about the interrelationships between one concept and another (Didik et al., 2019).

The cause of incompleteness in the current era is that learning is less fun and somewhat monotonous. In addition, the learning carried out is only centered on the teacher and books, making students quickly feel bored while learning (Aditia, 2022). Therefore, this is one of the teacher's problems regarding creating a learning atmosphere in the classroom so that students become active and interested, feel comfortable, and enjoy participating in learning (Muharni et al., 2021). With the development of the times, the rapid development of information and communication technology is no exception in computer technology. Advances in computer technology can be used as an opportunity to advance learning activities which are expected to help solve learning problems that are being faced (Roschelle et al., 2000).

In this condition, only educators know the needs of their students. Therefore, the process of designing learning media must be carried out by educators themselves so that learning media can suit the needs and conditions of their students. To support the achievement of learning media that follow human life goals, in the current era, educators can use tools that can make it easier for them to understand what they are learning (Study et al., 2021). It should be noted that making instructional media that follows the conditions of students in the current era is not easy, especially if it has to be linked to making programs. So that in overcoming this problem, we need an intermediary that is simple and easy but capable of producing learning media that follows the wishes of educators in meeting student needs. Therefore, we need a game concept that both educators and students easily apply.

Because the world of education is growing and advancing, various things need to be done to improve the quality and quantity of education to improve the quality of education which can package learning in the classroom so that students become active and excited, feel comfortable and happy in participating in learning, various breakthroughs are needed. Both in adding to the curriculum, learning innovation, and fulfilling educational facilities and infrastructure (Irmayani et al., 2018). To increase student learning motivation, teachers are required to be able to create innovative learning media to encourage students to learn well in class.

Learning that involves active interaction between educators and students can be carried out in a fun way by focusing on students so that they can participate actively in the learning process. Applications associated with AR or Augmented Reality, such as Unity, can be maximized as a means of interaction between educators and students in learning activities. Augmented reality is a technology that can combine three-dimensional or two-dimensional objects that project these objects and can be displayed in the real world (Kurniawan and Kusuma, 2021). With the rapid development of technology, we can take advantage of this technology in visualizing learning materials, one of which is Augmented Reality (AR). Augmented reality combines real and virtual objects in a real environment. Merging real and virtual objects is possible with appropriate display technology through devices such as mobile phones and laptops with cameras that support scanning an object (Irfansyah and Anifah, 2022).

Innovated learning media using augmented reality can increase students' interest in learning during the learning process. This is because augmented reality can also be used as entertainment besides having a side for learning. In addition, augmented reality also involves all five senses of students to make students more focused when explaining the material. This is because augmented reality has a function that can be used as a learning medium, namely providing information and motivational stimulation or interest (Estudante et al., 2020).

The use of augmented reality-based learning media can have a positive impact on students. This can be seen in students' enthusiasm to become more interested in seeing pictures of metamorphosis in animals that can be visualized in three dimensions in an exciting way. Not only that, but the use of augmented reality can also be created in introducing a form of object that can be implemented into learning, one of which is introducing geometric shapes, planetary shapes, and animals and plants related to learning (Merliana et al., 2019). The benefits of augmented reality technology can shorten the time in delivering material so that students don't get bored quickly.

Based on the exploration results of previous studies, the researcher also found several previous studies that are relevant to this research. However, there are slight differences from previous studies, such as using the picture and picture method to classify animals based on their food which can motivate students to increase student activity in the learning process. However, this study used 3 cycles, where the first cycle was only successful at 16.7%, so the picture and picture media were considered ineffective because it had to go through 3 cycles to obtain maximum results (Taonah, 2016).

Based on several previous studies, using augmented reality-based learning media is a fun learning medium. Augmented reality can make learning media more interactive, so learning activities using media in augmented reality applications significantly influence student creativity in understanding learning material (Didik et al., 2019). Therefore, researchers are interested in innovating with the title "Science Learning Innovation Using Augmented Reality in Animal Metamorphosis Material". This innovation is important because it relates to the achievement of student learning. Through this innovation, the developer will design a learning program in the form of an augmented reality-based application that makes it easier for students to understand metamorphosis material in animals (Mundy et al., 2019). Thus, simple but interactive media is made so that students can easily apply it and easy to understand it.

2. METHODS

In this research design, we used the Multimedia Development Life Cycle (MDLC) model. According to Mustika et al., (2018) in MDLC, it can be done in six stages, namely concept

(making concepts or goals), design (making display designs), material collecting (collecting materials needed for making programs), assembly (making according to with the design stage, testing (trial), and distribution (distribution process) **(Figure 1)**.
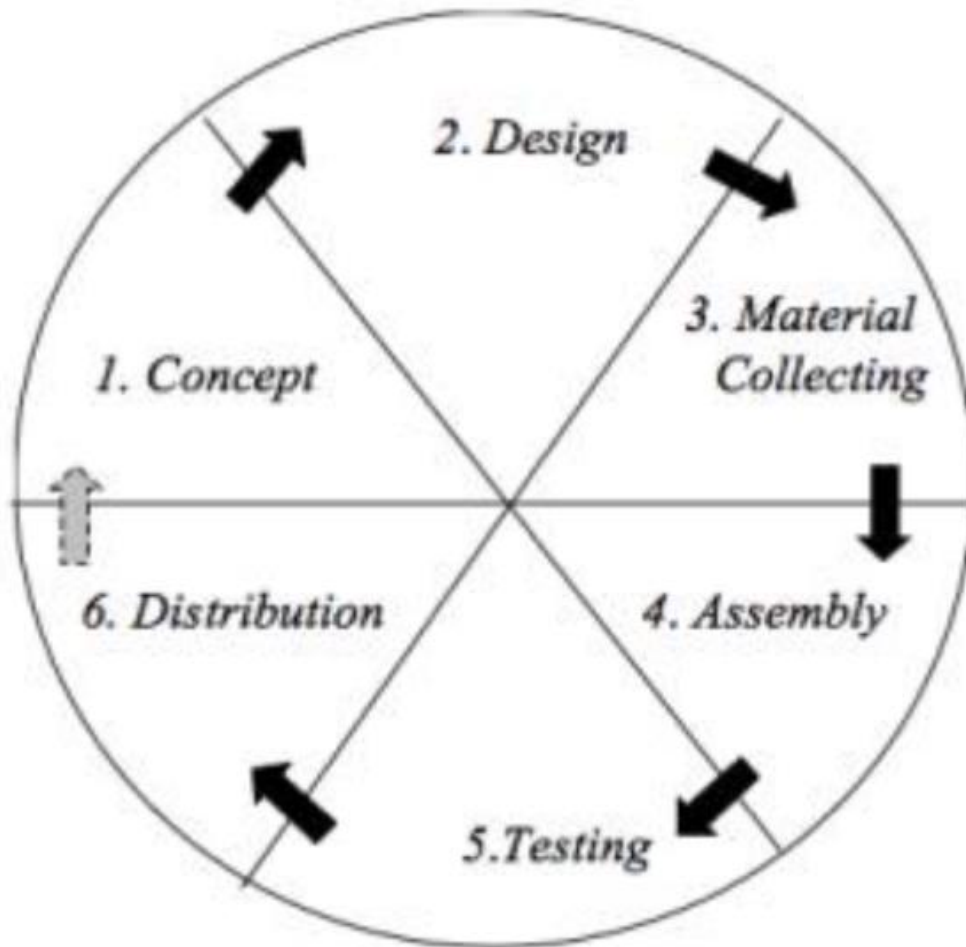

Figure 1. MDLC stages.

2.1. Concept (Making concepts)

This stage is the initial stage of MDLC. This stage contains the stages for determining the concept design so that it has clear goals for making media applications (Ahmad et al., 2021). This goal can be a target for anyone who will use the media application and the benefits of the media for users.

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2.2. Design (Making display designs)

This stage is for making detailed specifications of the program structure, appearance, style, and project material requirements to make it easier to see in the outline what media applications will be made. This stage uses a storyboard to make a picture or a series of designs that will be made that it is easy to understand.

2.3. Material collecting

This stage is to collect various materials needed for the work process. These materials include audio, images, text, animation, clip art, stickers, and so on, which can be obtained free of charge or by purchase from another party (Hoban et al., 2007).

2.4. Assembly (Making media applications)

This stage is for making media applications based on the design stage.

2.5. Testing (Trial implementation)

This stage is the stage for testing media applications after completing the assembly stage. Testing can be done by checking whether the application can run as expected. Testing is carried out twice; the first is alpha testing, where alpha testing is the testing carried out by the maker in the form of checking buttons or proper functions, while the next test is beta testing, where this testing is the testing carried out by users or outside parties other than the maker.

2.6. Distribution (Distribution process)

This stage is the final stage after the application is declared fit for use and there are no multifunction errors. After that, an evaluation was also conducted to determine the need for development in this media application product.

3. RESULTS AND DISCUSSION
3.1. The Process of Designing Learning Media

The process of designing learning media on animal metamorphosis material is as follows. The first is a concept; this learning media is an augmented reality application that functions to help elementary school students to get to know in real-time and interact more closely with animal metamorphosis material in Natural Sciences (IPA) subjects. The second is design, making a material content design regarding animal metamorphosis, which includes perfect and imperfect metamorphosis and records the need for animal images and the buttons needed in the application. The third is Collecting, collecting the materials needed to make the application. Materials needed, namely metamorphosis material starting from the definition

of metamorphosis, types of metamorphosis, and examples and pictures of animals that undergo metamorphosis. Apart from that, the materials collected are pictures of buttons such as play, back, next, and home buttons and buttons to go to a specific page. At this stage, he also collects animals that have undergone a perfect and imperfect metamorphosis in the form of three-dimensional images for augmented reality. This search is done through Unity assets.

The Fourth Stage of assembly is making learning media in the form of augmented reality applications using the Unity application. Previously, the appearance of "scenes" used in the application was made using the help of the Canva application. After that, each view is inserted into the prepared scenes then a three-dimensional image for augmented reality is inserted and arranged according to the design in the previous stage. Fifth, testing, this stage is carried out repeatedly to check that the application follows the design and can be used according to its function. Checking is carried out by the application development team, known as alpha testing. Sixth distribution, storing applications in a storage medium. The storage media used is Google Drive and on the developer's device.

3.2. The Process of Designing Learning Media

The results of making learning media as augmented reality applications using Unity are as follows. In the initial appearance of the application, a play button is used to start the application. When this application is opened, the user will immediately hear music (back sound) **(Figure 2)**.

Figure 2. Application initial view.

When the play button clicks, it will move to the next display, the main menu display. On the main menu, five buttons are used to make it easier for the user when going to a particular view or scene. The buttons on the main menu display are buttons for understanding metamorphosis, perfect metamorphosis, examples of perfect metamorphosis, imperfect metamorphosis, and examples of imperfect metamorphosis **(Figure 3)**.

Figure 3. Main menu.

When the definition of metamorphosis button is clicked, the display will change to an explanation of metamorphosis. In this view, there is also a back button to return to the previous display, a next button to go to the next display, and a home button to return to the main menu **(Figure 4)**.

Figure 4. Understanding metamorphosis display.

The user can click the next button to go to the next screen. However, users can also click the home button to return to the main menu and choose another view to go to. From the main menu, when the perfect metamorphosis button is clicked, the display will change to an explanation of perfect metamorphosis **(Figure 5)**.

Figure 5. Perfect metamorphosis display.

From the perfect metamorphosis display, when the next button is clicked, the display will change to the camera view to scan images of examples of animals that experience perfect metamorphosis in the form of augmented reality **(Figure 6)**.

Figure 6. Scanned image examples of animals experiencing a perfect metamorphosis display.

The user can move to the following view from the perfect metamorphosis camera scan view when clicking the next button. The following display is an example of an animal's life cycle that undergoes a complete metamorphosis from egg to adult. From the main menu, this view can also be accessed if the example perfect metamorphosis button is clicked **(Figure 7)**.

Figure 7. Example of perfect metamorphosis display.

When the next button in **Figure 7** is clicked, the display will change to the imperfect metamorphosis display, which contains an explanation of imperfect metamorphosis and the animal's life cycle. The imperfect metamorphosis display can also be accessed by clicking the imperfect metamorphosis button on the main menu **(Figure 8)**.

Figure 8. Imperfect metamorphosis display.

From the imperfect metamorphosis display, when the next button is clicked, the display will change to the camera view to scan images of examples of animals that experience imperfect metamorphosis in the form of augmented reality **(Figure 9)**.

Figure 9. Scanned image examples of animals experiencing an imperfect metamorphosis display.

From the imperfect metamorphosis camera scan view, the user can change to the following view by clicking the next button. The following display is an example of an animal life cycle that undergoes an imperfect metamorphosis. From the main menu, this view can also be accessed if the example of the imperfect metamorphosis button is clicked **(Figure 10)**.

Figure 10. Example of imperfect metamorphosis display.

Four images can be scanned in this augmented reality application. In perfect metamorphosis, three images can be scanned, namely images of frogs, bees, and ants. In imperfect metamorphosis, one image can be scanned, namely the image of a spider. Animal images that can be scanned are the only images provided. Images cannot be scanned if they are not images that have been provided, even though the animal in question is the same. The results of the scanned image in a three-dimensional image can be enlarged or reduced and rotated according to the user's wishes. The following is a picture of the animal for the AR scan and the results of the AR scan **(Figure 11)**.
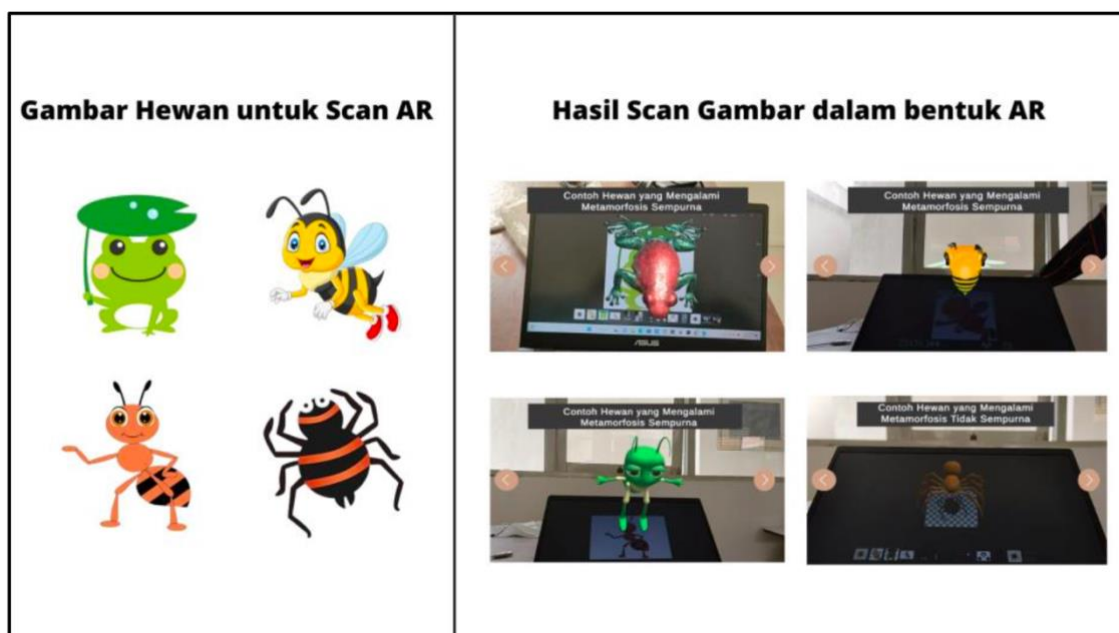
Figure 11. Images of animals for scans and Their AR scan results.

4. CONCLUSION

Based on the research we have done; it can be concluded that innovative science learning media with augmented reality on animal metamorphosis material can be appropriately designed and developed using the Multimedia Development Life Cycle development model or commonly abbreviated as MDLC. The MDLC model goes through six stages, namely concept (making concepts related to the goals and users of the application), design (designing the appearance of the application), collecting (collecting metamorphosis material for application content), assembly (making applications using Unity Hub), testing (testing app usage), and distribution (store apps in Drive as well as install apps on devices).

After being tested and tried, the results show that the application of science learning media with augmented reality on animal metamorphosis material can run well and smoothly so that it is ready to be used as an innovative learning medium for students. Therefore, it is necessary to conduct further research on other materials using the MDLC development model and the Unity Hub's assistance to create augmented reality-based applications.

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6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

7. REFERENCES

Aditia, E. (2022). The effectiveness of tynker and scratch application to improve 4C skills in ecosystem themes in Klumpit Public Elementary School. *Journal Title*, *Volume*(Issue), 1–6.

Ahmad, I., Rahmanto, Y., Pratama, D., dan Borman, R. I. (2021). Development of augmented reality application for intro ducing tangible cultural heritages at the Lampung museum using the multimedia development life cycle. Ilk. J. Ilm, 13(2), 187-194.

Didik, P., Konsep, P., Aryani, P. R., Akhlis, I., dan Subali, B. (2019). Penerapan model pembelajaran inkuiri terbimbing berbentuk augmented reality pada peserta didik untuk meningkatkan minat dan pemahaman konsep IPA. *UPEJ Unnes Physics Education Journal*, *8*(2), 90–101.

Estudante, A., and Dietrich, N. (2020). Using augmented reality to stimulate students and diffuse escape game activities to larger audiences. Journal of Chemical Education, 97(5), 1368-1374.

Hoban, G. F. (2007). Using slowmation to engage preservice elementary teachers in understanding science content knowledge. Contemporary Issues in Technology and Teacher Education, 7(2), 75-91.

Irmayani, H., Wardiah, D., and Kristiawan, M. (2018). The strategy of SD Pusri in improving educational quality. International Journal of Scientific and Technology Research, 7(7), 113-121.

Irfansyah, J., dan Anifah, L. (2022). Media pembelajaran pengenalan hewan untuk siswa sekolah dasar menggunakan augmented reality berbasis android. *Journal of Engineering, Technology, and Applied Science*, *4*(2), 86–96.

Kurniawan, Y. I., dan Kusuma, A. F. S. (2021). Aplikasi augmented reality untuk pembelajaran salat bagi siswa sekolah dasar. *Jurnal Teknologi Informasi Dan Ilmu Komputer*, *8*(1), 7.-14.

Kusumah, R. G. T., Walid, A., Pitaloka, S., Dewi, P. S., dan Agustriana, N. (2020). Penerapan metode inquiry sebagai usaha untuk meningkatkan hasil belajar IPA pada materi penggolongan hewan di Kelas IV SD Seluma. *Jurnal Pendidikan Matematika dan IPA*, *11*(1), 142-153.

Landay, J. A., and Myers, B. A. (2001). Sketching interfaces: Toward more human interface design. *Computer, 34*(3), 56-64.

Mundy, M. A., Hernandez, J., dan Green, M. (2019). Perceptions of the effects of augmented reality in the classroom. *Journal of Instructional Pedagogies*, *22*, 1-15.

Merliana, N. P. E., Putra, B. A. A., dan Gunawan, I. G. D. (2019). Teknologi augmented reality sebagai inovasi media pembelajaran Agama Hindu. *Maha Widya Bhuwana: Jurnal Pendidikan, Agama Dan Budaya*, *4*(2), 73–74.

Muharni, M., Alpusari, M., dan Putra, Z. H. (2021). Pengembangan media pembelajaran sains berbasis Prezi untuk siswa sekolah dasar pada materi penggolongan hewan. *Journal of Natural Science and Integration*, *4*(1), 85-93.

Mustika, M., Sugara, E. P. A., dan Pratiwi, M. (2018). Pengembangan media pembelajaran interaktif dengan menggunakan metode Multimedia Development Life Cycle. *Jurnal Online Informatika*, *2*(2), 121-126.

Nurajizah, S. (2016). Implementasi Multimedia Development Life Cycle pada aplikasi pengenalan lagu anak-anak berbasis multimedia. *PROSISKO: Jurnal Pengembangan Riset dan Observasi Sistem Komputer*, *3*(2), 14-19.

Rusnandi, E., Sujadi, H., dan Fauzyah, E. F. N. (2016). Implementasi Augmented Reality (AR) pada pengembangan media pembelajaran pemodelan bangun ruang 3D untuk siswa sekolah dasar. *INFOTECH Journal*, *1*(2), 24-31.

Roschelle, J. M., Pea, R. D., Hoadley, C. M., Gordin, D. N., and Means, B. M. (2000). Changing how and what children learn in school with computer-based technologies. The Future of Children, 76-101.

Studi, P., Guru, P., Dasar, S., Pendidikan, F. I., dan Madura, U. T. (2021). Analisis media pembelajaran seluncur satwa dalam pelajaran IPA materi pengelompokan hewan berdasarkan jenis makanan untuk kelas IV sekolah dasar, *9*(1), 135-150.

Sudihartinih, E., Wilujeng, S., and Rachmatin, D. (2021). Desain media pembelajaran matematika topik faktor persekutuan terbesar (FPB) berbasis aplikasi Scratch. *Jurnal Pendidikan Matematika Universitas Lampung*, *9*(4), 456-466.

Taonah, T. (2016). Penggunaan metode Picture and Picture untuk meningkatkan prestasi belajar siswa pada materi penggolongan hewan berdasarkan jenis makanannya mata pelajaran IPA kelas IV SD Negeri 3 Purwojati semester I tahun pelajaran 2015/2016. *Academy of Education Journal*, *7*(1), 36-44.