

Development of Android Application-Based Game Media in Learning About Cells for 2nd Grade High School Student

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Abstract: In this digital era, innovation is needed in the field of education, especially as a learning media. This research aims to develop game media based on Android applications for learning about cell for 2nd grade high school students. The development of this game media is based on the ADDIE model which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The game media was designed with Construct 2 and Canva applications to be interactive and effective in helping students understand the concept of cell biology. The effectiveness of the game media was evaluated through a trial involving 2nd grade high school students. The evaluation results show that this game media can help students understand the concept of cell biology as evidenced by the average score of students reaching 83.76.

Keywords: ADDIE, Android Application, Cells Biology, Concept of Cell, Game Media.

Introduction

In recent years, the integration of technology into education has become increasingly significant, particularly in the utilization of mobile learning. The use of Android-based educational games has gained attention due to their potential to enhance the learning experience and increase student engagement. Mobile learning applications enable students to access learning resources anytime and anywhere, providing a flexible and interactive learning environment (Ari et al., 2021).

In biology education, understanding cell structure and function is fundamental yet often challenging for students. Cells, as the basic unit of life, consist of various organelles that perform specific functions necessary for survival (Alberts et al., 2015). However, learning about cells through traditional methods may not be engaging enough for high school students, who often find the topic abstract and difficult to visualize (Kerr et al., 2020). This is where game-based learning can provide an

interactive platform that simplifies complex concepts, making them more accessible and engaging for students (Kim & Ko, 2021).

Android app-based games offer a unique opportunity to present cell concepts in a fun yet educational format. These games utilize multimedia elements such as animation, sound, and interactive tasks, which have been shown to improve students' cognitive retention (Sung & Hwang, 2013). In addition, the games provide immediate feedback, so students can learn from mistakes and strengthen their understanding (Hung et al., 2018).

This study aims to develop an Android application-based game media for learning about cells targeted at grade 2 high school students. By incorporating game elements into the learning process, this research seeks to evaluate whether game-based learning can significantly improve students' understanding and engagement with cellular biology.

Materials and Methods

This research employs the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation), which is widely used in instructional design to systematically develop educational media (Branch, 2009). The ADDIE model consists of five phases. In the Analysis phase, the needs of 2nd-grade high school students were assessed, focusing on challenges in understanding the concept of cells. The Design phase involved creating the game's structure, content, and multimedia elements. During Development, the game was created using Construct 2, with content based on credible sources. In the Implementation phase, the game was piloted with students to evaluate its usability. Finally, the Evaluation phase examined the results of the media trial in the learning environment of 2nd-grade high school students at Madrasah Aliyah Sunan Panandaran to determine the media's effectiveness in supporting students' understanding of the concept of cells.

Results and Discussion

Result

The development of the web-based game media was guided by the ADDIE model, which is structured into five key stages: Analysis, Design, Development, Implementation, and Evaluation. Each stage played a critical role in ensuring the effectiveness and usability of the final product

1. Analysis

This stage involved identifying the needs and characteristics of the target students in 2nd senior high school and determining the learning objectives for the game media. Based on observations in interviews conducted by teachers with students at MA Pandanaran, the concept of cells is classified as material that is difficult for students to understand. The concept of the cell covers the structure of plant and animal cells, cell organelles, and membrane transport systems.

2. Design

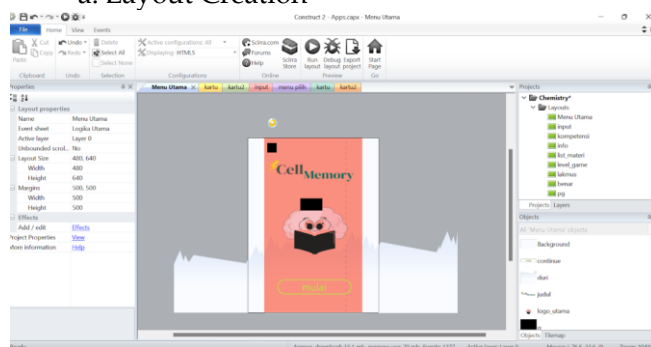
The teaching media is designed as an android application-based game. The game is memory

match. This game is an interactive game designed to test and improve the player's memory skills through matching pairs of hidden cards or pictures. In this game, players will be given a number of cards that are face-down and arranged in a certain pattern (for example, in rows and columns). Each card has a specific picture or symbol, and the player's job is to find two matching cards by flipping them over one by one.

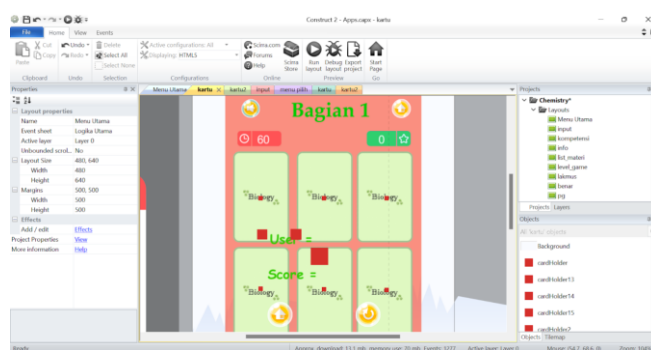
3. Development

The game created in Construct 2 and object created in Canva. This stage includes the following steps:

a. Layout Creation

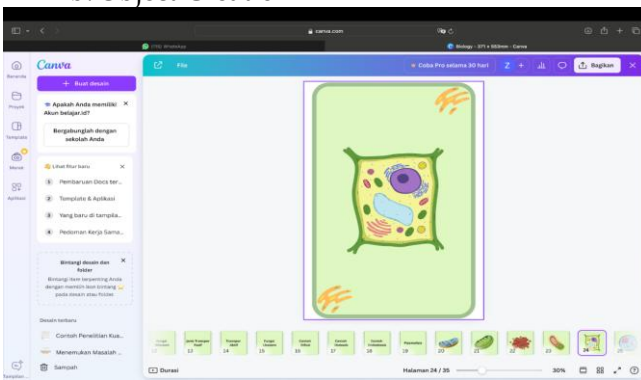


Picture 1. Designing the initial interface, main menu, and game screen.



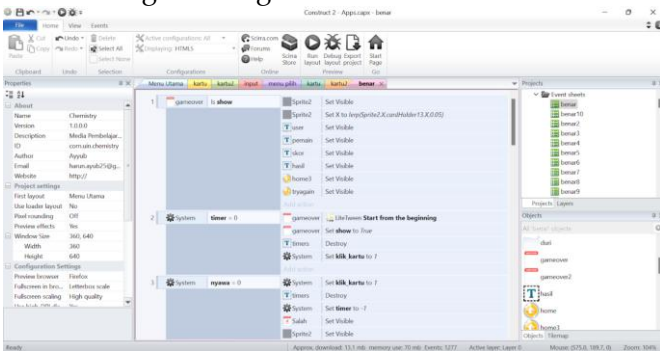
Picture 2. Layout organization of cards, buttons, and other elements.

b. Object Creation



Picture 3. Creating card objects with images of cell organelles or cell parts, background objects, buttons, and other interactive elements.

c. Programming



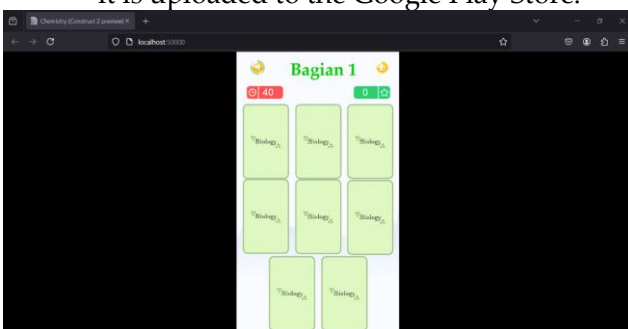
Picture 4. Setting up the game logic (e.g. how to match cards, score system, and next level) and using Construct 2's event system to manage user interaction with the game. Implement additional features such as sound, animation, and visual effects.

d. Testing and Evaluation.

Testing is done to ensure the game can be used properly. After that, an evaluation of the game's suitability for learning objectives is carried out as well as fixing any bugs or shortcomings found.

e. Packaging and Distribution Export

Export the Construct 2 project as an APK (Android Package Kit) file. For distribution, it is uploaded to the Google Play Store.



4. **Implementation:** The implementation stage involved piloting the game media with a small group of 2nd senior high school students to gather feedback and make necessary revisions. Internal testing is conducted to ensure the game runs smoothly and as designed. In addition, testing with students was conducted to gather feedback on the interface, gameplay, and learning effectiveness.

5. **Evaluation:** The evaluation stage was carried out by assessing the effectiveness of the game media in improving students' understanding of cell biology concepts and student learning motivation through the average acquisition of student scores.

Discussion

Implementation of Android application-based game media in learning has been shown to effectively enhance students' understanding of complex biological concepts, such as cell biology. By incorporating interactive elements and competitive features, the game was both engaging and motivating for students. This interactive design allowed learners to visualize intricate cell structures and biological processes, making abstract concepts more accessible. Previous research has highlighted that such mobile learning tools can engage students and support deeper learning by enabling visualization (Demir & Akpınar, 2018). Mobile applications can also allow students to interact with cellular structures and understand their roles in a more engaging and enjoyable manner (Labster, 2024).

The success of this game as a learning medium is evidenced by the results of a trial with 26 students with an average score of 83.76. This can also be supported by several key factors. The interactive design of the game maintains student interest through varied mechanisms, while the content is relevant and meaningful, directly linked to important cell biology concepts. These results are in line with broader trends in educational technology, where mobile apps are recognized for their ability to improve student engagement and learning outcomes (Naik, 2017). Similarly to the iCell application, a 3D interactive simulation by a previous developer, allows students to explore animal, plant, and bacterial cells, making it easier

for them to grasp fundamental concepts about cell structure and function (HudsonAlpha, 2024).

Conclusions

The development of an android application-based game media for learning about cells for 2nd-grade senior high school students has the potential to enhance student learning and engagement. The results of this research demonstrate the success of game-based learning as a tool for teaching cells by the result of the student test with an average score of 83.76. Future research could explore the long-term impact of game-based learning on student achievement and motivation.

References

Journal:

- Ari, A. S., et al. (2021). Mobile Learning in Biology Education: A Meta-Analysis. *International Journal of Instructional Media and Learning Environments*, 23(2), 123-140. <https://doi.org/10.1201/ijimle-2321>
- Demir, K., & Akpınar, E. (2018). The effect of mobile learning applications on students' academic achievement and attitudes toward mobile learning. *Malaysian Online Journal of Educational Technology*, 6(2), 48-59.
- Hung, C.-M., Hwang, G.-J., & Huang, I. (2018). A project-based digital game development approach to improving students' learning motivation, problem-solving skills, and learning achievement. *Educational Technology & Society*, 21(4), 159-171. <https://doi.org/10.1177/0735633117749410>
- Kerr, M. A., & Symonds, M. (2020). An evaluation of learning style theory and its utility in an educational environment. *Innovations in Education and Teaching International*, 57(2), 175-186. <https://doi.org/10.1080/14703297.2020.1738574>
- Kim, S., & Ko, H. (2021). The impact of game-based learning on biology education: An empirical study. *Journal of Educational Multimedia and Hypermedia*, 30(3), 101-119. <https://doi.org/10.1017/jemh-3081>
- Naik, G. H. (2017). Role of iOS and android mobile apps in teaching and learning chemistry. In *Teaching and the Internet: The Application of Web Apps, Networking, and Online Tech for Chemistry Education* (pp. 19-35). American Chemical Society.
- Sung, H.-Y., & Hwang, G.-J. (2013). A collaborative game-based learning approach to improving students' learning performance in science courses. *Computers &*

Education, 63, 43-51. <https://doi.org/10.1016/j.compedu.2012.11.019>

Book:

- Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2015). *Molecular Biology of the Cell* (6th ed.). Garland Science.
- Branch, R. M. (2009). *Instructional Design-The ADDIE Approach*. New York: Springer.

Web

- HudsonAlpha. (2024). *iCell® 3D cell model*. Retrieved from <https://icell.hudsonalpha.org>.
- LABSTER. (2024). *LABSTER VIRTUAL LABS FOR BIOLOGY*. RETRIEVED FROM <HTTPS://WWW.LABSTER.COM>