Journal of Soft Computing Exploration

Homepage: htttps://shmpublisher.com/index.php/joscex

p-ISSN: 2746-7686
e-ISSN: 2746-0991

.

Mobile game design for elementary school mathematics educative games

Roy Jordy[1], Hendra Marcos[2], Jaka Wijaya Kusuma[3], Dhanar Intan Surya Saputra[4], Purwadi[5]
[1,2,4]Department of Informatics, Universitas Amikom Purwokerto, Indonesia
[3]Department of Mathematics, Universitas Bina Bangsa, Indonesia
[5]Center for Advanced Computing Technology, Universiti Teknikal Malaysia Melaka, Malaysia

Article Info

Article history:

Received Jan 13, 2023
Revised Jan 19, 2023
Accepted Mar 6, 2023

Keywords:

Educational game
Game development life cycle
Mathematics
Mobile game

ABSTRACT

Mobile games or games in this era are very much in demand by young people and young people as a medium of entertainment, and parents often even play mobile games. This is what drives many game developer programmers to create mobile-based games. This study aims to develop a mobile game design that has been obtained from the Game Designer and Creative Director in the form of a scenario. Game scenarios are obtained as learning resources in the form of books. The design of this game is expected to be used by programmers to develop games ready for use. So that this game is expected to be used as an alternative learning media that is ready to add insight, especially at the age of children so that they are more enthusiastic about learning mathematics through educational games, namely mobile games. The academic side of the game stems from the simple and fun math puzzles. From within this game, players can enjoy games that have 2D animation and are based on Android, enrich children's knowledge and learn basic mathematical calculations using this educational game. The scoring of this educational game is based on the number of correct answers. The method used in this study is in the form of collecting information and data which includes recording and literature study as well as conducting searches using the internet including data sources related to problems in research. The development of this game uses the Game Development Life Cycle (GDLC) approach as the method. GDLC is a guide that can set the rules for creating educational games. The results of this study will be realized in the form of mobile or android-based games with construct 2 for elementary school children in grades 3, 4 and 5.

Corresponding Author:

Roy Jordy,
Department of Informatics,
Universitas Amikom Purwokerto,
Jl. Let. Jend. Pol Sumarto Purwokerto, Central Java, 53127, Indonesia.
Email: jordyroy202@gmail.com

1. INTRODUCTION

Developments and changes in world information and communication technology in the world today are very rapid. These changes and actions have caused many changes in people's behavior and activities in everyday life. Many technologies are developing rapidly, including information and communication technology in cell phones or mobile phones. Mobile or mobile technology is not only used for communication

but can also make it easier or can be used as a medium of entertainment from the cellphone or mobile [1], [2]. The technology that can be used from a cellphone or cellphone has many facilities, such as accessing the internet as an online learning medium. Materials and teaching materials that may be virtualized in many digital forms make learning more engaging and dynamic, and they can serve as a reference and inspire students to better understand the information as part of the learning process [3], [4]. Students can communicate and discuss with teachers through a variety of tools, including YouTube, Whatsapp, school e-learning Web, and Google Meet [5], [6]. There are many entertainment media such as music, access or watching movies from a cellphone, and games or mobile games that anyone can play whenever [7], [8].

A game or game is a fun medium that does not make people who play it feel bored. Most people play mobile games only to fill their free time. Games or mobile games are in great demand by all ages, from children and adults to even old age [9], [10]. Mobile games have wide varieties and types, with backgrounds in sports, adventure, wars, and many others. Mobile games are currently in great demand because they are a medium of entertainment, eliminate stress, sharpen and improve ability to as sports media (eSport) [11], [12], [13]. This is of course if done in moderation, because the negative impact of the game is also quite a lot of concern, such as the risk of eye health, problematic communication to acute addiction [14], [15], [16]. The current game in the great market is the Mobile Legends game which is very popular and exciting because you can play together, and there are many heroes to choose from according to what the player wants when playing. But games that are very rare to find, even enthusiasts, are rare, namely games with educational backgrounds. Many game developers wish educational games to be the most popular, especially among children. However, as a medium for learning and entertainment, fun with educational backgrounds is in great demand among children. They don't get bored or bored quickly. Games with educational experiences or games will be able to provide different learning and increase learning enthusiasts without being boring and fun [17], [18].

Educational games are designed for the learning process in the form of games based on Android or mobile. They teach students, especially children, in specific learning processes and develop concepts and understanding to make them more accessible. The purpose of making this educational game specifically for grade 3, grade 4, and grade 5 elementary school children is to foster students' interest in the learning process so that they better understand the material to be studied in the form of games or games [19]. This educational game is based on Android or smartphones. Android is a mobile phone operating system based on Linux. Android is a computer code-based software that may be freely released or known as open source, allowing programmers to create new applications in it [20]. There is an Android Market that gives hundreds of programs which free and paid, and contains a native Google application that is integrated, such as push email (Gmail), Google Maps, and Google Calendar. Android devices can display data in real-time [21], the Android Software Development Kit (SDK) was used to create the application which was written in Java. This SDK includes development tools like as a debugger and software library, a QEMU-based handset emulator, sample code, documentation, and tutorials [22].

The Android operating system is also considered very user friendly and can be adapted to the needs of each user [23]. This is the factor why Android is so popular around the world [24]. It is easy to access anywhere and anytime because elementary school students in grades 3, 4, and 5 can already operate smartphones or Android cell phones. Learning in the form of games usually includes learning for children, such as learning to read and do the math. Learning to calculate using media games or games is far more exciting and attractive to children than using stationery and paper.

Learning math can be tricky for some people, especially children. However, through game-based learning, learning mathematics can be more fun and easy. Research has shown that effective learning begins with a positive frame of mind. The best way to learn math concepts is through play. Putting the blackboard aside and hands-on learning with free math games can help kids overcome the mental block in math that comes with the pressures of the national math curriculum. Approaching math problems from this perspective allows students to enjoy the process of solving cool math games and motivates them to keep practicing. Learning by having fun is much more entertaining for mathematics learners and has the same goals as the mathematics taught in class. Counting is elementary learning in mathematics [25]. Addition, subtraction, multiplication, and division are basic mathematical calculations. The definition of mathematics is a person's way of thinking in organizing, and mathematics is language terms with clear, precise, and precise definitions [26]. in educational games that will be designed using Construct 2 about basic calculations.

Construct 2 is a game or game engine and a tool that can be used to make games. A game engine is a software system designed to be the basis for developing video games, such as games on computers, consoles, or mobile phones. Game engines can be used by developers to create games for video game consoles, mobile

game, and other sorts of computers [27], [28]. In this research, the games produced are mainly in the form of 2-dimensional animation using HTML5 (Hyper Text Markup Language). The main goal of HTML5 development is to improve HTML technology to support the latest multimedia technologies, which are easy to read by humans and understand by machines. HTML5 includes everything a game developer needs, including offline asset storage, 2D and 3D graphics, maps, animations, physics, audio APIs, and browser compatibility [29], [30]. Construct 2 has the advantage of being fast and accessible [31]. Having an easy-to-understand layout display speeds up the game's design or manufacture. So whatever is visible in the layout design is the interface or collection when the game is run. That way, it will make it easier to complete elementary school mathematics learning applications for grades 3, 4, and 5 elementary schools [32].

2. METHOD

2.1. Collecting Data and Information

Effective data collecting can aid in the resolution of a problem [33]. Although data might be beneficial, having too much information is cumbersome, and having the wrong data is pointless. The approach used to collect data can be the difference between important insights and time-wasting misinformation [34]. The method used in this research involves collecting data and information by using primary data through on-site survey activities, then making observations, conducting experiments, giving questionnaires, and conducting personal interviews. As well as the information in this research, the first person to read it then writes or records it and looks for other data sources related to the problem to be studied.

2.2. System Development Methodology

The method used in this study uses the Game Development Life Cycle (GDLC) approach. The GDLC is a software development life cycle with the goal of entertaining users [35]. When compared to the software development life cycle, developers confront several problems when building games, and hence they use a distinct approach known as GDLC [36], [37]. Though there is not any precise specific lifecycle of every successful game [38], [39]. The GDLC is one of a process for making educational games [40], with a flow of stages as shown in Figure 1:

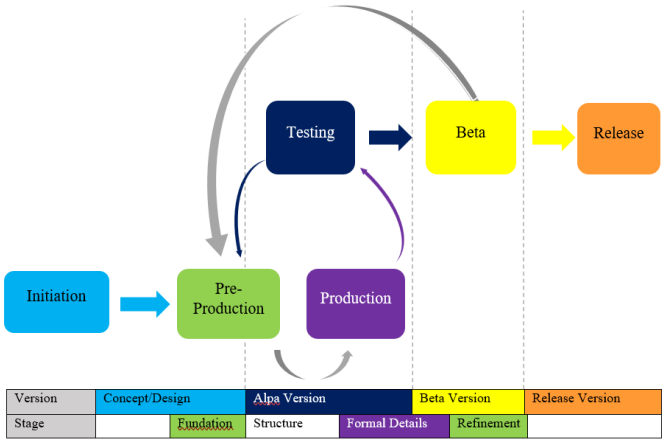

Figure 1. GDLC Stages

a) Initiation is the starting point where a project develops a game. Early game development begins with making a game with a game idea. The beginning is a session where developers meet, exchange ideas, and discuss games that will be designed. Developing a competition or game starts with a repeated process or stage called the production cycle.
b) Pre-production starts the production cycle of a game or game design. Pre-production is crucial before beginning production because the game is designed for display at this stage or process. At this stage, it includes a game or game design, significantly to refine the concept of the game and game documentation.
c) The production stage, so from the pre-production design stage, it is perfected at the production stage. This means this stage focuses on translating game designs, concept art and other aspects so that they become the building blocks of the game or games. Steps include asset creation, programming, and integration between assets and SC (source code).
d) Trial or testing at this testing stage is carried out with internal testing or testing. If the game or game that is made is feasible enough to enter the beta version, then it will proceed to beta (next). If it is not possible, it will be returned or repeated to the pre-production stage to reconsider what to do next.

e) Beta Stage, when a game or game has been made, it does not mean the public can accept the match or tournament. Testing or external testing. This beta testing is done to check the acceptance of the game or games and will check for bugs and claims submitted by third-party testers. The Beta Stage is already out of the production cycle, but the results of this test can potentially cause the production cycle to repeat itself.

f) Release, at this point a game has actually been made and completed beta testing by indicating that the game or game is ready to be released publicly. Release is the stage where the final version of the game is officially released [41].

3. RESULTS AND DISCUSSIONS

3.1. Pra-Production

1) Storybord

Storyboards are sketches of drawing designs that have been arranged sequentially according to the story script that has been made. Or an overview of scenarios in the activities of the entire application [42]. Story ideas and game scenarios are taken from textbooks used for learning in class. The textbook has been adjusted to the level of each class, namely grades 3, 4, and 5. An example of the display of the textbook used is shown in Figure 2.

Figure 2. Example of the textbook

2) Flowchart system

The flowchart here is used to facilitate preparing the media flow. In building a system, it must be related to one another [43]. To get to the target to be addressed, each of these sections has or has different functions and duties, namely the process of interaction in educational games about mathematics with the user or users. The following is a design flowchart in an educational game about mathematics, Figure 3:

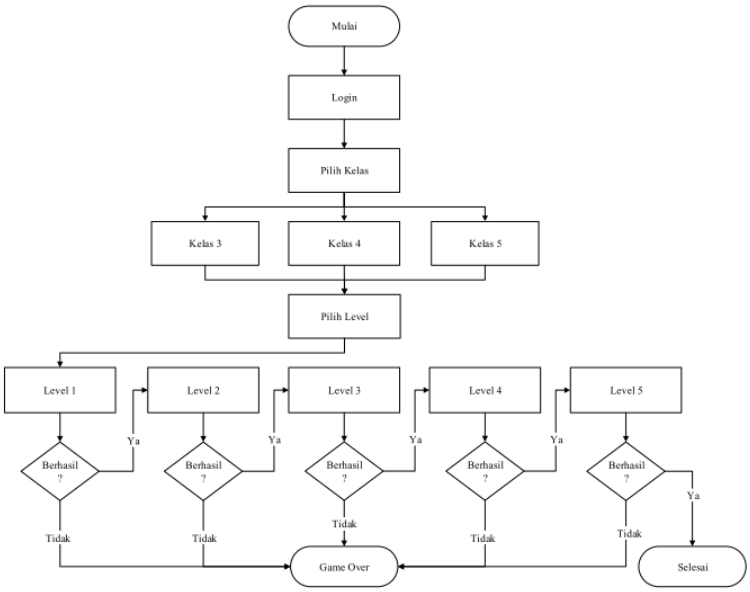

Figure 3. Flowchart stage

.

a) Login page
On this page, the player will be asked to log in first. The first page appears when a new player or user, and the new user will enter a name.
b) Main page
On this page, there is a play button or play button, and this button will immediately play or play the game, then there is a sound on/off button whose function is to turn on or off the sound of the song from the background, and the help button here is to find out the tutorial or how to play the game. These buttons will be available on the next page.
c) Menu page
On this main menu page, a new player or new user will be asked to choose classes 3, 4 and 5.
d) Levels menu
The level menu will display the difficulty level. There will be stages in this level menu, and each group has difficulty. New players must be able to complete grades 1, 2, 3, 4, and level 5. In this game, you will have a life or life. To continue the game, you will have to have a lot of energy; if the life runs out, it will be game over or game back on a previous level. and if this level is completed without a game over, then it will continue at the next level or stage.
e) New player or newbie
Starting to play educational or educational games about mathematics and starting from the lowest level, namely 1, to the highest, namely level 5 and will display a score based on the user or the user playing it.

3.2. Prototype Game

At this prototype stage, it will display the design that will be built on this educational game about mathematics, such as the design on the Main Menu page layer, the method of the start screen page or start the game, the creation of the level screen page, procedure the Quiz screen page, setup the score screen page, design the score screen page. The player has resolved the ending screen or the game.

a) Main game display
On this main page is the display before entering the main menu page.

Figure 4. Main game display

b) Main course page display
This page contains the main page for elementary school educational games or games, players or users who can choose according to their class. There are three class menus with different difficulty levels, including from grades 3, 4 and 5 of elementary school.

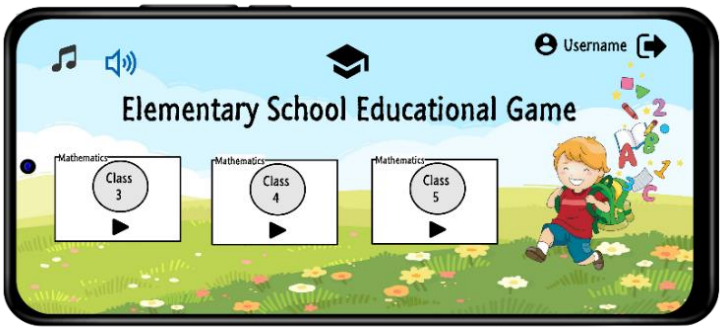

Figure 5. Main course page display

c) Class 3 display menu
On this menu page, this player who has chosen class 3 will display the math level for class 3. This game starts with level or level 1 up to level 5.

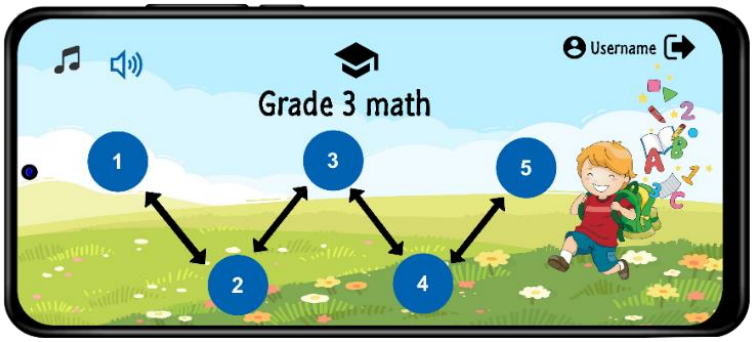

Figure 6. Class 3 display menu

d) Menu display in class 4
The class 4 menu will display a screen with the class 4 submenu level. This game starts with level 1 and goes up to level 5.

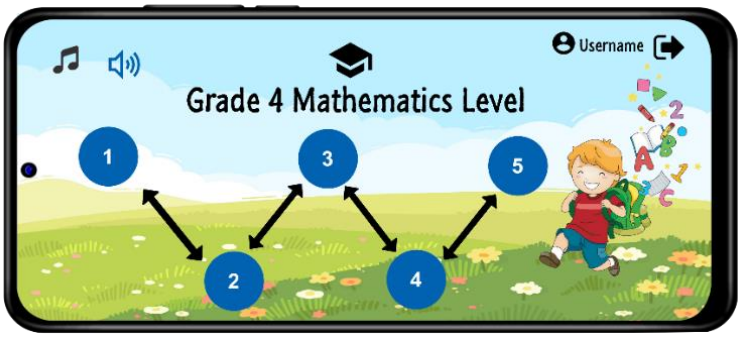

Figure 7. Menu display in class 4

e) Menu display in class 5
The class 5 menu will display a screen with the difficulty level of the class 5 submenu level. This game starts with level 1 and goes up to level 5.

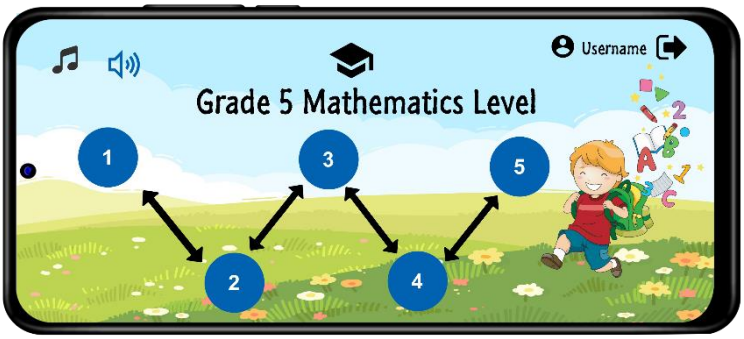

Figure 8. Menu display in class 5

f) Game page level 1
After the player has chosen the class, it will be immediately taken to the level. On the level 1 menu, the user will play with the level of difficulty level 1.

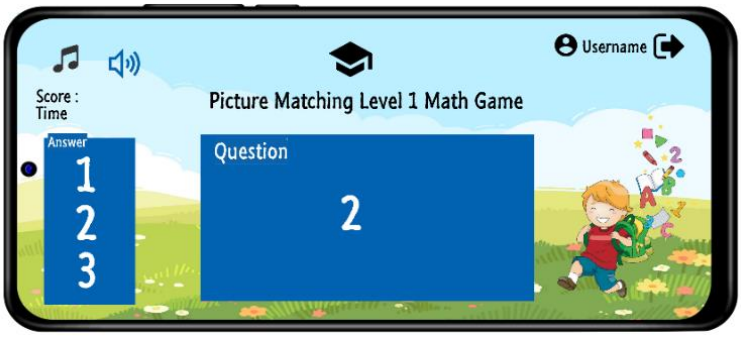

Figure 9. Screen display level 1

g) Level 2 game page menu
After the level 1 game is successful, it will continue to the next level, level 2. On the level 2 menu, the user will play with the level of difficulty level 2.

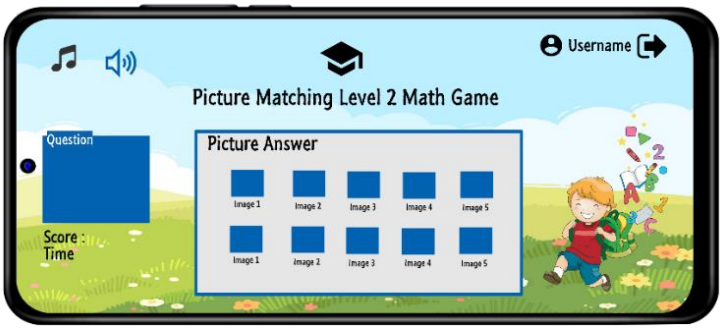

Figure 10. Screen display level 2

h) Game page menu at level 3
After the level 2 game is successful, it will continue to the next level, level 3. On the level 3 menu, the user will play with level 3 difficulty.

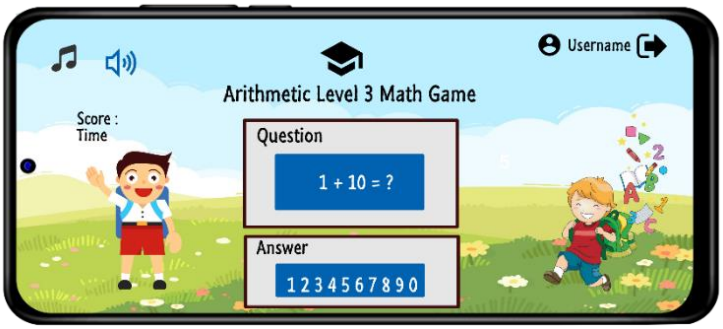

Figure 11. Screen display level 3

i) Game page at level 4
After the level 3 game is successful, it will continue to the next level, level 4. On the level 4 menu, the user will play with the level of difficulty level 4.

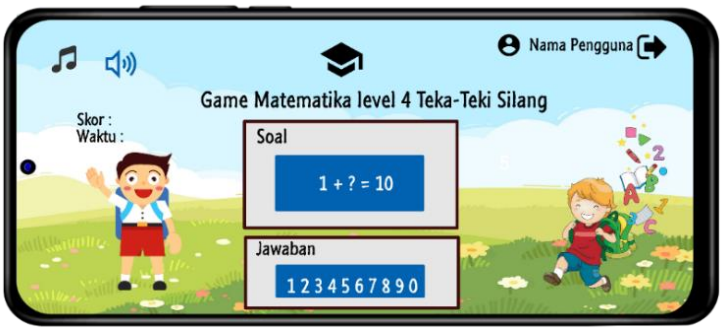

Figure 12. Screen display level 4

j) Game page at level 5
After the level 5 game is successful, it will continue to the next level, level 5. On the level 5 menu, the user will play with the difficulty level 5.

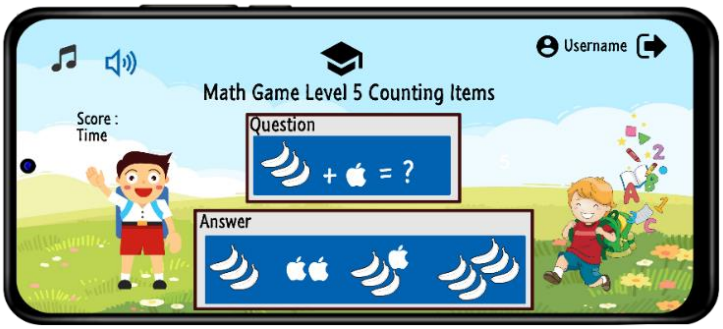

Figure 13. Screen display level 5

k) Game over display
After all, levels have been completed, this menu will display the results passed in the previous story. The user or users who have completed it will display a score based on the user or users who were given it when playing the game.

Figure 14. Screen display game over

4. CONCLUSION

From the results of the research that has been done, it can be concluded that the mobile game design has been successfully made following the appearance, material, and flow of the learning process in the textbooks used in grades 3, 4, and 5 by the teacher. The developed game design can be applied and tested for further research to support it as a basic math educational game for grades 3, 4, and 5. Math educational games are made with the Construct 2 game engine because Construct 2 can make games more intuitive and easy to read. After all, there are no such complex programming languages in it.

REFERENCES

[1] A.-R. Jung and J. Heo, "The effects of mobile phone use motives on the intention to use location-based advertising: the mediating role of media affinity and perceived trust and risk," *Int. J. Advert.*, vol. 41, no. 5, pp. 930–947, 2022, doi: https://doi.org/10.1080/02650487.2021.1974204.

[2] S. Salmiyanti, D. Darmansyah, and D. Desyandri, "Peran Media Pembelajaran Berbasis Teknologi Informasi Dan Komunikasi Di Sekolah Dasar," *J. Pendidik. dan Konseling*, vol. 4, no. 6, pp. 11424–11429, 2022, doi: https://doi.org/10.31004/jpdk.v4i6.10230.

[3] J. Beyer, Y. Yang, and H. Pfister, "Visualization Design Sprints for Online and On-Campus Courses," *IEEE Comput. Graph. Appl.*, vol. 41, no. 6, pp. 37–47, 2021, doi: 10.1109/MCG.2021.3115413.

[4] I. Ketut Sudarsana, K. Pusparani, N. N. Selasih, N. K. Juliantari, and P. Wayan Renawati, "Expectations and challenges of using technology in education," *J. Phys. Conf. Ser.*, vol. 1175, no. 1, 2019, doi: 10.1088/1742-6596/1175/1/012160.

[5] P. I. Pramesti, J. R. Prasetya, T. O. Dwi Lestari, and M. G. Khoirunnisa, "Application of TOPSIS Method in Assessment of the Best Learning Comunication Media for Elementary School Students," *J. Soft Comput. Explor.*, vol. 3, no. 1, pp. 44–54, 2022, doi: 10.52465/joscex.v3i1.66.

[6] D. I. S. Saputra and I. Setyawan, "Virtual YouTuber (VTuber) sebagai Konten Media Pembelajaran Online," *Pros. SISFOTEK*, vol. 5, no. 1, pp. 14–20, 2021.

[7] Y. Yulia, N. M. B. R. Purba, and J. Nasir, "Aplikasi Game Edukasi Matematika Berbasis Android," *Indones. J. Comput. Sci.*, vol. 8, no. 2, pp. 101–112, 2019, doi: 10.33022/ijcs.v8i2.196.

[8] I. Sarifah *et al.*, "Development of Android Based Educational Games to Enhance Elementary School Student Interests in Learning Mathematics," *Int. J. Interact. Mob. Technol.*, vol. 16, no. 18, 2022, doi: https://doi.org/10.3991/ijim.v16i18.32949.

[9] J. Krath, L. Schürmann, and H. F. O. Von Korflesch, "Revealing the theoretical basis of gamification: A systematic review and analysis of theory in research on gamification, serious games and game-based learning," *Comput. Human Behav.*, vol. 125, p. 106963, 2021, doi: https://doi.org/10.1016/j.chb.2021.106963.

[10] I. Widaningrum, H. Prasetiyo, I. P. Astuti, and others, "Android Based Math & Trash Educational Game Using Scirra Construct 2 and Adobe Phonegap," *J. RESTI (Rekayasa Sist. Dan Teknol. Informasi)*, vol. 4, no. 1, pp. 37–49, 2020, doi: https://doi.org/10.29207/resti.v4i1.1385.

[11] R. Windawati and H. D. Koeswanti, "Pengembangan Game Edukasi Berbasis Android untuk Meningkatkan hassil Belajar Siswa di Sekolah Dasar," *J. Basicedu*, vol. 5, no. 2, pp. 1027–1038, 2021, doi: 10.31004/basicedu.v5i2.835.

[12] D. I. S. Saputra and S. W. Handani, "Penggunaan Visual Programming Language pada Game Engine untuk Membangun Game 3 Dimensi," *Telematika*, vol. 8, no. 1, 2015, doi: 10.35671/telematika.v8i1.260.

[13] F. Gao, L. Li, and Y. Sun, "A systematic review of mobile game-based learning in STEM education," *Educ. Technol. Res. Dev.*, vol. 68, no. 4, pp. 1791–1827, 2020, doi: https://doi.org/10.3991/ijet.v14i07.10315.

[14] Z.-Y. Liu, Z. Shaikh, and F. Gazizova, "Using the concept of game-based learning in education," *Int. J. Emerg. Technol. Learn.*, vol. 15, no. 14, pp. 53–64, 2020.

[15] S. Reyssier, S. Hallifax, A. Serna, J.-C. Marty, S. Simonian, and E. Lavoué, "The impact of game elements on learner motivation: influence of initial motivation and player profile," *IEEE Trans. Learn. Technol.*, vol. 15, no. 1, pp. 42–54, 2022, doi: 10.1109/TLT.2022.3153239.

[16] L. D. Anggraeni and H. Wihardja, "Online game, addiction and learning achievement of senior high school students in Jakarta," *Indones. J. Disabil. Stud.*, vol. 7, no. 2, pp. 151–155, 2020.

[17] A. Fatahillah, N. Alfiyantiningsih, and D. Dafik, "Developing Construct 2 Android-Based Education Math Game to Improve the ICT Literacy on Number Patterns Subject," *Al-Jabar J. Pendidik. Mat.*, vol. 12, no. 1, pp. 25–34, 2021, doi: https://doi.org/10.24042/ajpm.v12i1.7896.

[18] N. Puspitasari and M. H. Wahyudi, "Mathematics Learning Application In The Form Of Android-Based Educational Games At Pancasila 4 Pracimantoro Junior High School," *Int. J. Comput. Inf. Syst.*, vol. 3, no. 4, pp. 163–170, 2022, doi: https://doi.org/10.29040/ijcis.v3i4.97.

[19] M. Adiwijaya, K. I. S, and Y. Christyono, "Perancangan Game Edukasi Platform Belajar Matematika Berbasis Android Menggunakan Construct 2," *Transient*, vol. 4, no. 1, pp. 128–133, 2015, doi: https://doi.org/10.14710/transient.v4i1.128-133.

[20] D. I. S. Saputra, S. W. Handani, K. Indartono, and A. Wijanarko, "SMART-In English: Learn English Using Speech Recognition," *J. Robot. Control*, vol. 1, no. 4, pp. 109–113, 2020, doi: 10.18196/jrc.1423.

[21] N. Kurniawan, "Electrical Energy Monitoring System and Automatic Transfer Switch (ATS) Controller with the Internet of Things for Solar Power Plants," *J. Soft Comput. Explor.*, vol. 1, no. 1, Sep. 2020, doi: 10.52465/joscex.v1i1.2.

[22] A. S. Mabruri and others, "Data Security System of Text Messaging Based on Android Mobile Devices Using Advanced Encrytion Standard Dynamic S-BOX," *J. Soft Comput. Explor.*, vol. 1, no. 1, pp. 39–46, 2020, doi: https://doi.org/10.52465/joscex.v1i1.10.

[23] K. Meers, E. Dejonckheere, E. K. Kalokerinos, K. Rummens, and P. Kuppens, "mobileQ: A free user-friendly application for collecting experience sampling data," *Behav. Res. Methods*, vol. 52, no. 4, pp. 1510–1515, 2020.

[24] D. A. Amanda and A. R. Putri, "Pengembangan Game Edukasi Pada Mata Pelajaran Matematika Materi Bangun Datar Berbasis Android di SDN 1 Jepun," *JOEICT (Jurnal Educ. Inf. Commun. Technol.*, vol. 3, no. 2, pp. 160–168, 2019, doi: https://doi.org/10.29100/joeict.v3i2.1241.

[25] Q. J. Adrian and A. Apriyanti, "Game Edukasi Pembelajaran Matematika Untuk Anak Sd Kelas 1 Dan 2 Berbasis Android," *J. Teknoinfo*, vol. 13, no. 1, p. 51, 2019, doi: 10.33365/jti.v13i1.159.

[26] M. Yunus, I. F. Astuti, and D. M. Khairina, "Game Edukasi Matematika Untuk Sekolah Dasar," *Inform. Mulawarman J. Ilm. Ilmu Komput.*, vol. 10, no. 2, p. 59, 2015, doi: 10.30872/jim.v10i2.192.

[27] K. H. Sharif and S. Y. Ameen, "Game Engines Evaluation for Serious Game Development in Education," in *2021 International Conference on Software, Telecommunications and Computer Networks (SoftCOM)*, 2021, pp. 1–6. doi: 10.23919/SoftCOM52868.2021.9559053.

[28] A. Chia, "The metaverse, but not the way you think: game engines and automation beyond game development," *Crit. Stud. Media Commun.*, vol. 39, no. 3, pp. 191–200, 2022, doi: https://doi.org/10.1080/15295036.2022.2080850.

[29] K. Sung, J. Pavleas, M. Munson, and J. Pace, "Working with HTML5 and WebGL," in *Build Your Own 2D Game Engine and Create Great Web Games*, Springer, 2022, pp. 19–61. doi: https://doi.org/10.1007/978-1-4842-7377-7_2.

[30] S. A. E. Campos, B. A. M. Morales, and Á. A. V. Núñez, "Open-Source Game Engine & Framework for 2D Game Development," in *2022 IEEE Engineering International Research Conference (EIRCON)*, 2022, pp. 1–4. doi: 10.1109/EIRCON56026.2022.9934816.

[31] Jada Ario Yustin, H. sujaini, and M. Azhar Irwansyah, "Rancang Bangun Aplikasi Game Edukasi Pembelajaran Matematika Menggunakan Construct 2," *J. Sist. dan Teknol. Inf.*, vol. 1, no. 1, pp. 1–5, 2016.

[32] R. Gunawan, T. H. Prastyawan, and Y. Wahyudin, "Rancang Bangun Game Edukasi Perhitungan Dasar Matematika Sekolah Dasar Kelas 3, 4 Dan 5 Mengunakan Construct 2," *J. Interkom J. Publ. Ilm. Bid. Teknol. Inf. dan Komun.*, vol. 16, no. 1, pp. 46–59, 2021, doi: 10.35969/interkom.v16i1.96.

[33] J. Song, Z. Han, W. Wang, J. Chen, and Y. Liu, "A new secure arrangement for privacy-preserving data collection," *Comput. Stand. Interfaces*, vol. 80, p. 103582, 2022, doi: https://doi.org/10.1016/j.csi.2021.103582.

[34] M. K. Alam, "A systematic qualitative case study: questions, data collection, NVivo analysis and saturation," *Qual. Res. Organ. Manag. An Int. J.*, 2020.

[35] L. Li, G. Freeman, and N. J. McNeese, "Channeling End-User Creativity: Leveraging Live Streaming for Distributed Collaboration in Indie Game Development," *Proc. ACM Human-Computer Interact.*, vol. 6, no. CSCW2, pp. 1–28, 2022, doi: https://doi.org/10.1145/3555173.

[36] L.-E. Dubois and J. Weststar, "Games-as-a-service: Conflicted identities on the new front-line of video game development," *New Media Soc.*, vol. 24, no. 10, pp. 2332–2353, 2022, doi: https://doi.org/10.1177/1461444821995815.

[37] B. Altan *et al.*, "Developing serious games for CBRN-e training in mixed reality, virtual reality, and computer-based environments," *Int. J. Disaster Risk Reduct.*, vol. 77, p. 103022, 2022, doi: https://doi.org/10.1016/j.ijdrr.2022.103022.

[38] A. Chia, "The artist and the automaton in digital game production," *Convergence*, vol. 28, no. 2, 2022, doi: https://doi.org/10.1177/13548565221076434.

[39] J. Mertens, "Broken Games and the Perpetual Update Culture: Revising Failure With Ubisoft's Assassin's Creed Unity," *Games Cult.*, vol. 17, no. 1, pp. 70–88, 2022, doi: https://doi.org/10.1177/15554120211017044.

[40] R. Yusianto, M. Marimin, S. Suprihatin, and H. Hardjomidjojo, "Strategic Planning for Green Logistics Implementation in Potato Agro-Industry," *J. Ilm. Teknol. Pertan. Agrotechno*, vol. 6, no. 1, p. 9, 2021, doi: 10.24843/jitpa.2021.v06.i01.p02.

[41] S. Wahyu, "SKANIKA: Sistem Komputer dan Teknik Informatika Penerapan Metode Game Development Life Cycle Pada Pengembangan Aplikasi Game Pembelajaran Budi Pekerti," *SKANIKA Sist. Komput. dan Tek. Inform.*, vol. V, pp. 82–92, 2022.

[42] P. Güntürkün, T. Haumann, J. Wieseke, and L. M. Edinger-Schons, "The dynamic effects of customers' attributions of coproduction motives for customer's satisfaction over time," vol. 2, no. 1, pp. 57–63, 2016.

[43] Q. Budiman, S. Mouton, L. Veenhoff, and A. Boersma, "程威特 1，吴海涛 1，江 帆 2," *J. Inov. Penelit.*, vol. 1, no. 0.1101/2021.02.25.432866, pp. 1–15, 2021.

.