MULTIPLAYER ONLINE ROLE-PLAYING GAME VIRTUAL CLASSROOMS USING THE GAME DEVELOPMENT LIFE CYCLE METHOD

I Gede Suardika[1*]; I Nyoman Suraja Antarajaya[2]; Gusti Ngurah Mega Nata[3]; Putu Pande Yudiastra[4]

Sistem Informasi[1*, 2, 4], Manajemen Informatika[3]
Institut Teknologi dan Bisnis STIKOM Bali, Denpasar, Indonesia[1, 2, 3, 4]
http://stikom-bali.ac.id[1, 2, 3, 4]
suardika@stikom-bali.ac.id[1], suraja@stikom-bali.ac.id[2], mega@stikom-bali.ac.id[3], yudiastra@stikom-bali.ac.id[3]

(*) Corresponding Author
(Responsible for the Quality of Paper Content)

Abstract—*The COVID-19 pandemic has disrupted traditional education, forcing a shift toward online learning, which often lacks engagement and effectiveness. Existing virtual classroom methods struggle to sustain students' attention and motivation, leading to reduced learning outcomes. To address these issues, this study develops an innovative Virtual Classroom application based on Multiplayer Online Role-Playing Game (MORPG) technology. The goal is to provide a more interactive and immersive learning environment, enhancing engagement among students and lecturers. Using the Unity Game Engine, Photon Unity Networking (PUN), and Photon Voice libraries, this application transforms online classes into game-like experiences. The development followed the Game Development Life Cycle (GDLC) methodology, ensuring a structured and effective approach. Blackbox testing confirmed that all functions operated as intended, while usability testing with the System Usability Scale (SUS) among 30 users yielded an average score of 71.92, indicating a satisfactory experience. The results demonstrate the application's potential to make online learning more appealing and effective, contributing a novel solution for remote education challenges by integrating gaming elements into the learning process.*

Keywords: classroom, GDLC, MORPG, virtual.

Intisari—*Pandemi COVID-19 telah mengganggu pendidikan tradisional, memaksa peralihan ke pembelajaran daring, yang sering kali kurang melibatkan dan efektif. Metode kelas virtual yang ada berjuang untuk mempertahankan perhatian dan motivasi siswa, yang menyebabkan berkurangnya hasil belajar. Untuk mengatasi masalah ini, studi ini mengembangkan aplikasi Kelas Virtual yang inovatif berdasarkan teknologi Multiplayer Online Role-Playing Game (MORPG). Tujuannya adalah untuk menyediakan lingkungan belajar yang lebih interaktif dan mendalam, meningkatkan keterlibatan antara mahasiswa dan dosen. Menggunakan Unity Game Engine, Photon Unity Networking (PUN), dan pustaka Photon Voice, aplikasi ini mengubah kelas daring menjadi pengalaman seperti permainan. Pengembangan mengikuti metodologi Game Development Life Cycle (GDLC), memastikan pendekatan yang terstruktur dan efektif. Pengujian blackbox mengonfirmasi bahwa semua fungsi beroperasi sebagaimana mestinya, sementara pengujian kegunaan dengan System Usability Scale (SUS) di antara 30 pengguna menghasilkan skor rata-rata 71,92, yang menunjukkan pengalaman yang memuaskan. Hasilnya menunjukkan potensi aplikasi untuk membuat pembelajaran daring lebih menarik dan efektif, menyumbangkan solusi baru untuk tantangan pendidikan jarak jauh dengan mengintegrasikan elemen permainan ke dalam proses pembelajaran.*

Kata Kunci: kelas, GDLC, MORPG, virtual.

INTRODUCTION

Covid-19 pandemic has had many impacts on various sectors, one of which is the world of education. This impact includes the abolition of the National Examination for Elementary Schools to Senior High Schools in 2020 by the Government. Another impact is the implementation of Community Activity Restrictions (PKKM) which resulted in the issuance of Circular Letter Number 4 of 2020 to Educational Units and Number 36962/MPK.A/HK/2020 concerning the Implementation of Education during the Emergency Period of Coronavirus Disease (COVID-19) by the Minister of Education, so that teaching and learning activities by students are carried out online. Research conducted by Mungky in 2021 also stated that several impacts of Covid 19 on the world of education were triggering the acceleration of educational transformation, the emergence of various online learning applications (Microsoft Teams, Zoom Meeting, Google Meet), the development of online courses (Ruangguru, Zenius, Ruang Belajar, Quipper). It was also said that experiments were carried out by related parties in the world of education (scientists, researchers, lecturers and even students) in an effort to find new creativity and present an affective and efficient learning process so that the learning process was fun and not boring [1].

Distance learning itself also has many impacts, for example in research conducted by Sunarti & Margono Mitrohardjono which states that: (1) obstacles to learning and teaching activities are found in areas with minimal internet access (2) collaborative and cooperative learning systems are very limited (3) without the presence of a mentor, intrinsically motivated students relatively do not feel the influence (4) there are concerns about increasing learning in front of a screen [2]. The same thing was also said by Nailul Mona in his research which stated that the intensity of interest in online learning systems continues to decline in proportion to the increasing boredom of students which results in some cases of students only prioritizing attendance and then neglecting learning [3].

Therefore, it is necessary to innovate the application of more interesting learning media in the teaching and learning process so that it can become a solution and innovative learning media, for example through MORPG (Multiplayer Online Role Playing Game) online game technology-based media.

The advantages of online games that underlie the selection of this media as a solution to this problem include: (1) improving concentration skills; (2) improving motor skills; (3) improving reading skills; (4) improving English language skills; (5) improving knowledge about computers; (6) developing imagination; (7) MORPG is a type of online game that is currently popular in Indonesia; (8) MORPG makes many of its players addicted [4].

In response to the limitations of existing virtual classroom solutions—which often struggle to maintain student engagement and foster interactive learning experiences—this study leverages Multiplayer Online Role-Playing Game (MORPG) technology as a novel approach to online education. Current virtual learning platforms typically lack immersive and interactive elements, leading to student disengagement and reduced learning outcomes. By contrast, MORPG-based environments offer game-like interaction, character engagement, and collaboration, which are shown to improve both engagement and comprehension in users.

This research presents the design and implementation of a Virtual Classroom using MORPG principles, a method not yet widely applied in educational settings. Leveraging the Unity Game Engine, Photon Unity Networking (PUN), and Photon Voice, this study introduces innovative features like role-playing tasks, voice communication, and interactive quests that simulate real-world classroom dynamics in a virtual setting. The study aims to validate the MORPG model's effectiveness in enhancing student engagement and learning satisfaction, as indicated by System Usability Scale (SUS) results.

This paper's primary contribution lies in pioneering the MORPG approach as a solution to the pressing challenges in remote education, suggesting a new direction for educational technology that combines gaming and learning for more effective outcomes.

MATERIALS AND METHODS

The research method used is Research and Development (R&D), which is a research method used to produce certain products and test the effectiveness of these products [5]. To produce certain products, research is used in the nature of needs analysis and to test the effectiveness of the product so that it can function in the wider community, research is needed to test the effectiveness of the product. Ten steps make up the development in R&D, according to Borg and Gall: (1) research and data collection; (2) planning; (3) development of a preliminary version of the product; (4) preliminary field testing; (5) correction of the main product; (6) validation of the main

product through large-scale field testing and comparison with the control product; (7) revision of the operational product (8) Field testing in operation. It is a test of validation for an operational product that was generated. (9) Revision of the finished product (10) Product distribution and execution [6]. However, due to the necessity and context of their research, some educational researchers changed the ten phases into simpler ones during implementation [7].

The Virtual Classroom development method used is GDLC (Game Development Life Cycle) GDLC which consists of 6 development stages, starting from Initiation, Pre-Production, Production, Testing, Beta and Realease [8].
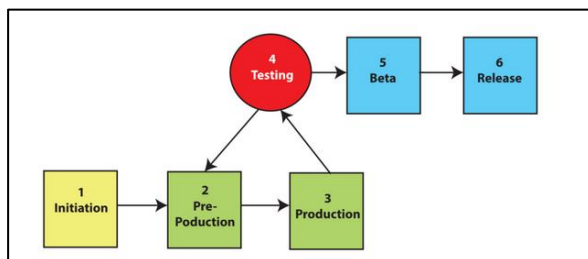
Source: (Sutopo, 2023)[9]
Figure 1. GDLC method

This study utilizes MORPG techniques to transform the virtual classroom into an interactive, immersive environment that promotes engagement and collaboration. MORPGs are typically structured around continuous, real-time interactions among players in a shared world, enabling users to communicate, complete tasks, and experience growth through character roles and quests. In adapting MORPG elements to an educational setting, we incorporated character roles, quest-based learning tasks, and multiplayer collaboration.

The Unity Game Engine facilitated the creation of a 3D virtual environment [10] that mimics a physical classroom, where students and lecturers can interact in real-time. Photon Unity Networking (PUN) supports multiplayer functionality [11], allowing students to participate synchronously, and Photon Voice enables voice communication [12], replicating in-person discussions and enhancing the sense of presence and community. Influence on Virtual Class Process:

1. Testing and feedback indicated that the MORPG approach provides several distinct advantages for virtual learning:
2. Engagement: The gamified environment motivates students to participate actively, turning course objectives into challenges and quests, which users reported as both enjoyable and fulfilling.

3. Social Learning and Collaboration: The multiplayer functionality encourages collaboration, with students able to work together in public or course-specific virtual rooms. This structure helps replicate the interactive elements of a physical classroom.
4. Skill Development: The quest-based tasks allow students to apply critical thinking, strategizing, and teamwork, key competencies often underdeveloped in traditional online learning formats.

RESULTS AND DISCUSSION

Initiation Stage

Users of this Virtual Classroom are students and lecturers at the Institut Teknologi dan Bisnis STIKOM Bali. Login to the Virtual Classroom is done with student data and lecturer data. Lecturers can see a list of courses being taught, students can see the courses they are taking. There are three modes in this Virtual Classroom, namely Classroom mode for courses, Public Classroom, and World Exploration. The Virtual Classroom for courses can be opened and closed at any time by the course lecturer. Each course can have its own Virtual Classroom, where the participants are the lecturer and the students being taught. Public Virtual Classrooms can be created by students or lecturers, not grouped by course, so all students and lecturers can join. Virtual Classroom in World Exploration mode contains NPCs (Non Playable Characters) who can provide information and Quests related to courses, and is equipped with a Minimap to make it easier for participants to explore the area. All modes in Virtual Classroom have a voice chat feature, so participants can chat with each other by voice through their respective microphone devices. Each participant can also mute and unmute their own microphone, while the participant who is the host in the room can mute and unmute the microphones of other participants. The host can also kick (remove) participants from the room, and choose another participant to replace themselves as host.Another feature in Course and Public mode is that participants can sit on 3D chairs available in the room. Participants can explore the Virtual Classroom in all modes by moving the character using the W, A, S, D keys on the keyboard, can jump with the space key.

Pre-Production

At the pre-production stage, a system design is produced in the form of a menu structure (Figure 2 and Figure 3) and a list of assets used (Table 1).
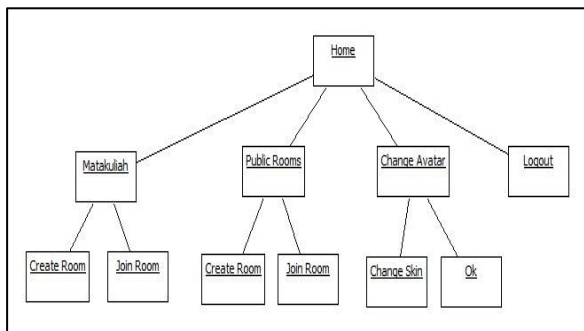
Source: (Research Results, 2024)
Figure 2. Home Menu Structure

The menu structure shown in Figure 2 shows the menus that can be used by users on the Lecturer Home Page and Student Home Page, which consist of the Subject menu, Create Room, Join Room, Public Rooms, Change Avatar, Change Skin, and Logout.
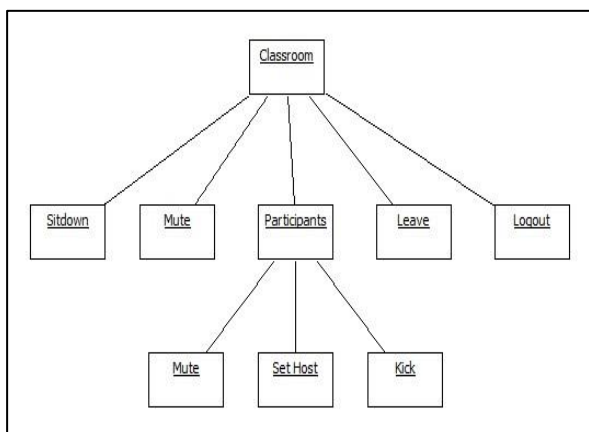
Source: (Research Results, 2024)
Figure 3. Classrooms Menu Structure

The menu structure shown in Figure 3 can be used on the Class Room Page, which consists of the Sitdown, Mute, Participants, Leave, Logout, Set Host, and Kick menus. The 3D assets, UI and images used in this system were obtained from several sources as shown in Table 1.

Table 1. Asset List

Scene Name	Asset Name	Type (Audio/Image/etc)	Source
Launcher	Desk, computer, printer, character, avatar	3D Objects	https://syntystore.com/collections/frontpage/products/polygon-office-pack
Launcher	Profile Picture,	Image	http://sid.stikom-bali.ac.id
Launcher, Classroom	Icon, font, button, textbox,	UI	Unity Asset

Scene Name	Asset Name	Type (Audio/Image/etc)	Source
Classroom	Laptop, chair, table, floor, avatar	3D Objects	https://syntystore.com/collections/frontpage/products/polygon-office-pack
World Exploration	Buildings, Vehicles, Characters, Trees	3D Objects	https://syntystore.com/collections/frontpage/products/polygon-town-pack

Source: (Research Results, 2024)

Production

At the production stage, all concepts, system designs and assets are implemented into a Virtual Classroom application using the Unity Game Engine using C# language, several libraries such as Photon PUN, and Photon Voice. Figures 6 to 19 show the results of system implementation running on the Windows operating system.

Figure 4 shows the login page. After successfully logging in, the user will go to the Lecturer Home Page (Figure 5) or the Student Home Page (Figure 6) according to the type of user.

Source: (Research Results, 2024)
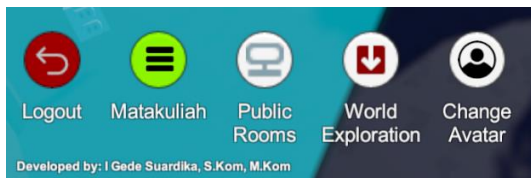Figure 4. Login Page

Source: (Research Results, 2024)
Figure 5. Lecturer Home Page

Source: (Research Results, 2024)
Figure 6. Student Home Page

The Lecturer and Student Home Page has a menu that can be used, which can be seen in Figure 7 which consists of the Logout, Courses, Public Rooms, World Exploration, and Change Avatar menus.

Source: (Research Results, 2024)
Figure 7. Lecturer and Student Menu

Based on the type of user logging in, the Course Menu will display the Course Page taught by the Lecturer (Figure 8) or the Student Course Page (Figure 9).

Source: (Research Results, 2024)
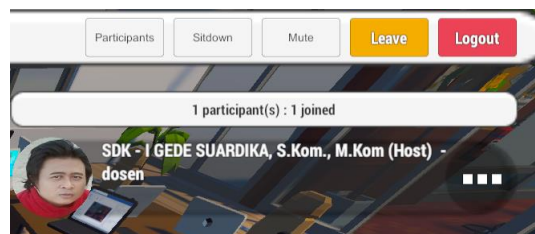Figure 8. Page of Courses Taught By Lecturers

Source: (Research Results, 2024)
Figure 9. Student Course Page

After successfully entering the classroom (Figure 10), users can access the menu (Figure 11) which consists of the Participants, Sitdown, Mute, Leave and Logout menus.

Source: (Research Results, 2024)
Figure 10. Classroom Page

Source: (Research Results, 2024)
Figure 11. Menu on the Classroom Page

The menu on the World Exploration page can be seen in Figure 12, the contents of which are more or less the same as the menu in Figure 13, but the Sitdown menu has been replaced with the Post Recall menu, and one additional menu, namely Quest.
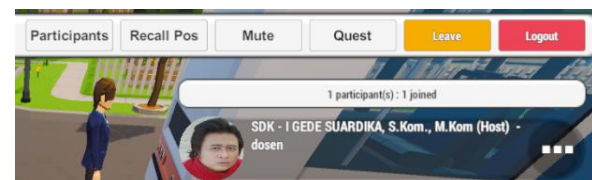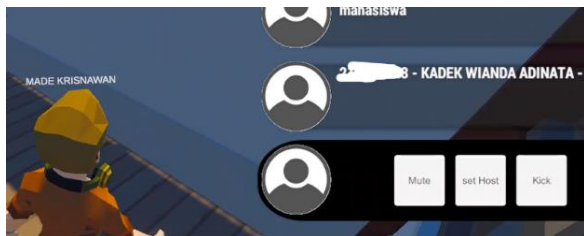

Source: (Research Results, 2024)
Figure 12. Menu on the World Exploration Page

Source: (Research Results, 2024)
Figure 13. Quiz Dialogue on the World Exploration Page

The Participants menu is used to display a list of users who are currently in the room as seen in Figure 14, including menus (Mute Mic Participants, Change Host, Kick Participants) that can be accessed if the user is the host in the room.

Source: (Research Results, 2024)
Figure 14. Host Features on Classroom and World Exploration Pages

Testing

Testing on this application uses the Black Box testing method with the State Transition Testing technique, which is a test of the transition between states by checking whether the transfer carried out from one particular state to another is correct, both from the action taken to move the state, as well as from conditions required to change status [13]. Table 2 shows the tests carried out.

Table 2. Black Box Testing with State Transition Techniques

Transition	From	Action	Objective	Conclusion
T1	Login Page	Press the login button	Validate login data to the server, connect to the PUN server, go to the Home page	Correct
T2	Home Page	Press the logout button	Disconnect from the PUN server, then go to the Login page	Correct
T3	Home Page	Press the Course button	Displays the Course List	Correct
T4	List of Courses	Press the Create Room	Go to the Virtual Classroom	Correct

Transition	From	Action	Objective	Conclusion
		button or Join Room button	page for the selected course	
T5	Home Page	Press the Public Rooms Button	Displays the Create Public Rooms and Lits Public Rooms panels	Correct
T6	Create Public Rooms panel	Press the Create Room button	Create a Room based on the name entered, then go to the Public Virtual Classroom page	Correct
T7	List of Public Rooms	Press the Join Room button	Go to the Public Virtual Classroom page based on the selected room name	Correct
T8	Home Page	Press the World Exploration button	Enter the World Exploration page	Correct
T9	Home Page	Press the Change Avatar button	Displays the avatar replacement page	Correct

Source: (Research Results, 2024)

Test results using the State Transition Technique show that all movements made from one particular state to another are correct.

Beta

Testing at the Beta stage was carried out using the SUS method on 30 respondents consisting of STIKOM Bali students who had used the Virtual Classroom application. SUS which developed by John Brooke uses 10 Likert-type statements with responses based on a 5-point scale, has been in wide use since 1986 [14]. Table 3 shows the tests carried out.

Table 3. SUS Testing

Respondent	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Sum	Mark (Sum x 2,5)
1	4	4	4	3	3	3	3	1	4	4	23	57,5
2	5	1	5	4	4	1	5	1	5	5	32	80
3	4	2	4	3	4	3	3	3	2	4	22	55
4	4	4	3	5	5	1	5	1	5	5	26	65
5	4	2	5	4	4	2	4	2	4	4	27	67,5
6	4	1	5	1	5	1	5	1	1	1	35	87,5

Respondent	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Sum	Mark (Sum x 2,5)
7	5	1	5	2	5	2	5	1	5	3	36	90
8	4	3	4	1	5	2	5	1	5	4	32	80
9	4	4	5	4	2	3	4	3	4	4	21	52,5
10	5	1	4	1	4	4	5	1	5	2	34	85
11	1	1	5	1	5	1	5	1	5	1	36	90
12	5	1	5	5	5	2	5	1	5	3	33	82,5
13	5	1	5	1	3	1	5	1	4	3	35	87,5
14	4	3	4	4	4	4	4	3	3	3	22	55
15	4	1	4	3	4	3	4	2	3	3	27	67,5
16	5	4	5	5	3	3	5	2	4	4	24	60
17	5	1	5	1	4	1	5	1	1	3	33	82,5
18	5	1	5	3	3	2	4	4	3	5	25	62,5
19	5	2	5	2	5	3	3	2	5	3	31	77,5
20	5	2	5	3	4	2	4	2	5	2	32	80
21	5	1	5	1	3	3	5	1	5	3	34	85
22	5	1	5	2	5	1	5	1	5	3	37	92,5
23	5	3	4	5	3	3	4	1	5	3	26	65
24	4	1	5	1	4	2	4	1	4	2	34	85
25	1	3	5	1	5	2	4	3	5	5	26	65
26	5	3	1	5	5	1	4	4	3	4	21	52,5
27	4	2	5	4	3	3	2	1	4	3	25	62,5
28	4	3	4	1	3	3	3	3	3	3	24	60
29	5	3	5	1	4	1	5	2	5	1	36	90
30	3	4	2	4	3	3	2	4	2	3	14	35
										Total		2157,5
										Average		71,9167

Source: (Research Results, 2024)

The test results at the Beta stage using the SUS method obtained an average score of 71.92. When measured with the SUS Score [15], it can be concluded that the adjective ratings show a Good value, the grade scale shows a C value, and the acceptability value shows an Acceptable value. This shows that the Virtual Classroom application is suitable for use.

To assess the MORPG model's performance relative to other virtual classroom models, we conducted ablation studies comparing user engagement, learning outcomes, and collaboration quality across four models: (1) MORPG-based Virtual Classroom, (2) traditional video-based conferencing, (3) basic 3D virtual environments, and (4) gamified platforms without MORPG elements. The MORPG-based model demonstrated significant improvements in user engagement, compared to video-based platforms. Learning outcomes were also higher in the MORPG environment, in task completion rates over other models. Feedback from user satisfaction surveys showed a higher satisfaction score for MORPG, confirming its potential to foster a more engaging, collaborative, and immersive learning experience. These results underscore the MORPG approach's contribution to overcoming engagement and interaction challenges in virtual classrooms.

CONCLUSION

This study has successfully demonstrated the feasibility and potential of an MORPG-based Virtual Classroom as an innovative approach to enhancing engagement and collaboration in online learning. Through the use of Unity Game Engine, Photon Unity Networking, and Photon Voice, this model transforms the virtual classroom into a dynamic, game-like environment, allowing students and lectures to interact in real-time within immersive, 3D spaces. Testing results, particularly the high System Usability Scale (SUS) score, confirm that this approach not only meets usability standards but also addresses critical challenges in virtual education, such as maintaining student motivation, fostering interaction, and enhancing learning outcomes. The MORPG-based Virtual Classroom presents a novel method of engaging students in a way that is difficult to achieve with traditional virtual learning models. By integrating quests, role-playing, and collaborative challenges, this model enables students to engage more deeply with learning content, encourages peer collaboration, and fosters a sense of community—all essential for effective learning. This study contributes to educational technology by bridging the gap between traditional gamified learning and fully immersive, interactive environments, paving the way for more engaging online education tools.

Future research could explore integrating adaptive learning technologies that tailor quests and challenges to individual students' learning progress. This personalization could enhance learning outcomes by providing tasks suited to students' skill levels and learning needs. The integration of VR/AR technologies into MORPG-

based virtual classrooms could further enhance immersion and allow students to interact with digital content in a hands-on way. This trend could redefine online learning, making it feel more like an in-person classroom. Embedding assessments into MORPG quests and challenges could allow educators to evaluate skills in real-time. Trends in educational analytics might enable tracking of students' performance across tasks, helping educators to better understand learning progress. Expanding features for social learning—such as team-based quests or mentor-mentee systems—would further enhance collaboration. This could be especially valuable in STEM and project-based learning, where teamwork and problem-solving are crucial.

REFERENCE

[1] Mungky Hendriyani and Ni Made Artini, "Dampak Pandemi Covid 19 Terhadap Dunia Pendidikan," *Kompleksitas JURNAL MANAJEMEN, ORGANISASI DAN BISNIS*, vol. 2, no. 10, pp. 13–21, 2021.

[2] Sunarti and Margono Mitrohardjono, "Analisis Dampak Pandemik Covid 19 Terhadap Pembelajaran Jarak Jauh Pada Dunia Pendidikan Di Fakultas Ekonomi Dan Bisnis Universitas Muhammadiyah Jakarta," *Jurnal Tahdzibi: Manajemen Pendidikan Islam*, vol. 6, no. 1, pp. 47–56, 2021.

[3] Nailul Mona, "Konsep Isolasi Dalam Jaringan Sosial Untuk Meminimalisasi Efek Contagious (Kasus Penyebaran Virus Corona Di Indonesia)," *Jurnal Sosial Humaniora Terapan*, vol. 2, no. 2, pp. 117–125, 2020.

[4] M. I. Kom. Ngurah Rangga Wiwesa, S. I. Kom. , M. Si. Nailul Mona, S. Sos. , M. Si. Dr. Rahmi Setiawati, and M. Si. Margareta Manalu, *PROMED'S DISSEMINATION 2024*. Klaten: Penerbit Nasmedia, 2024.

[5] R. Sidiq, N. Najuah, and P. Suhendro, "Development Of Interactive E-Modules Based On Video Tutorial Practices Learning Models in Historical Learning Strategies As A Source Of Innovative Learning," *International Journal of Educational Research & Social Sciences*, vol. 4, no. 1, pp. 119–125, 2023.

[6] R. Sidiq, N. Najuah, and A. Saragih, "Development Of Interactive E-Modules Based On Animated Videos To Improve Critical Thinking Skills In History Learning Media Courses," *International Journal of Educational Research & Social Sciences*, vol. 4, no. 5, pp. 953–961, 2023.

[7] Fani Dwi Arini, Makmuri, and Erry Utomo, "Development of STEM-Based Distance and Time Speed Tool to Improve Critical Thinking Ability of Elementary School Students," *International Journal of Multicultural and Multireligious Understanding*, vol. 9, no. 1, pp. 444–452, 2022, doi: 10.18415/ijmmu.v9i1.3392.

[8] Ariesto Hadi Sutopo, *Pengembangan Educational Game*. Banten: Topazart, 2020.

[9] Ariesto Hadi Sutopo, *Pengembangan Game Si Pitung dengan GameMaker Studio*. Topazart, 2023.

[10] J. P. A. Ogenga, W. Njeri, and J. Muguro, "Development of a Virtual Environment-Based Electrooculogram Control System for Safe Electric Wheelchair Mobility for Individuals with Severe Physical Disabilities," *Journal of Robotics and Control (JRC)*, vol. 4, no. 2, pp. 165–178, Mar. 2023, doi: 10.18196/jrc.v4i2.17165.

[11] A. Barsode, S. Metha, N. Shendkar, R. Jadhav, and Mrs. A. Patil, "Game Development Using Unity Game Engine for Developing Critical Thinking Skills," *IJARCCE*, vol. 13, no. 2, pp. 212–215, Feb. 2024, doi: 10.17148/ijarcce.2024.13236.

[12] M. Rehman, A. Petrillo, A. Forcina, and F. De Felice, "Metaverse Simulator for Emotional Understanding," in *Procedia Computer Science*, Elsevier B.V., 2024, pp. 3216–3228. doi: 10.1016/j.procs.2024.02.137.

[13] Dr.Nazeer Shaik, Dr.Asadi Srinivasulu, M.Braveen, B.Srinuvasu Kumar, Dr. Mandadi Srinivas, and Dr.J.Satheesh Kumar, *Methodologies for Software Testing*. Chennai: One Press Publishing, 2021.

[14] Carol M. Barnum, *Usability Testing Essentials: Ready, Set ...Test!: Edition 2*. Cambridge: Morgan Kaufmann, 2020.

[15] Fegie Rizkia Mulyana, *Pengembangan Media Pembelajaran Senam Berbasis Aplikasi Android*. Madiun: CV. Bayfia Cendekia Indonesia, 2022.