Jurnal Pendidikan Multimedia (EDSENCE)

Journal homepage: *https://ejournal.upi.edu/index.php/Edsence*

Developing 2D Animation with a Lateral Thinking Theme Using Facial Motion Capture

Saiful Yahya[1], Ivan Eliansah[2], Anang Kukuh Adisusilo[3], and Adita Ayu Kusumasari[4]

[1,2,4] STIKI MALANG, Malang, Indonesia

[3] Universitas Wijaya Kusuma, Surabaya, Indonesia

Correspondence: E-mail: yahya@stiki.ac.id

ABSTRACT

Lateral thinking is the ability to think critically using unconventional thought patterns, crucial for problem-solving. This study explores the use of 2D animation as a visual communication medium to convey lateral thinking concepts. By employing facial motion capture technology, the animation production process was accelerated and simplified. A 2D animation prototype was developed and evaluated with 25 undergraduate students in the field of design through a comprehension test and survey. Results showed that 90% of respondents understood the lateral thinking concept after viewing the animation. These findings demonstrate that facial motion capture is proved effective in optimizing the production process of 2D Animations by reducing manual effort in facial animation. This research contributes to the field of visual communication by integrating innovative animation technologies for educational purposes. Future studies should further explore the application of facial motion capture in creating educational 2D animations on STEM (Science, Technology, Engineering and Mathematics) and other interdisciplinary themes.

ARTICLE INFO

Article History:
Submitted/Received 29 Oct 2024
First Revised 30 Nov 2024
Accepted 25 Dec 2024
First Available online 27 Dec 2024
Publication Date 30 Dec 2024

Keyword:
2D Animation,
facial motion capture,
lateral thinking,
visual communication.

1. INTRODUCTION

Lateral Thinking refers to the ability to solve problems using non linear, unconventional approaches. That is a crucial aspect of cognitive development, especially for adolescents. Studies indicate that students exposed to lateral thinking training demonstrate improved creativity and problem solving abilities (Mustofa & Hidayah, 2020).

Lateral thinking refers to the ability to solve problems using non-linear, unconventional approaches, making it a crucial aspect of cognitive development, especially for adolescents. Implementing lateral thinking in educational settings can enhance group creativity and problem-solving skills. Studies indicate that students exposed to lateral thinking training demonstrate improved creativity and problem-solving abilities (Mustofa & Hidayah, 2020). Additionally, lateral thinking enhances students' ability to approach complex problems, proving essential in disciplines such as mathematics. However, adolescence also presents unique challenges, such as social pressures and the desire for conformity, which can hinder creative thinking (Blakemore, 2018).

2D animation serves as a versatile educational medium, capable of improving audience comprehension and engagement. Research shows that animation significantly boosts students' motivation and interest in learning (Nursolehat, 2024). It has also proven effective in increasing literacy among adults about chronic illnesses, as evidenced by greater motivation to adopt healthier lifestyles after viewing animated content on diabetes and hypertension (Pichayapinyo, 2024). Moreover, in Tanzania, educational animations have enhanced children's skills in drawing and number recognition (Borzekowski, 2018).

Developing 2D animation requires a combination of technical expertise and creative thinking. Advances in artificial intelligence and biomechanical modeling have revolutionized traditional animation practices, enabling animators to incorporate motion simulations and interactions that enhance production efficiency (Dai, 2024). Facial motion capture technology, initially developed for 3D animation, has emerged as a valuable tool in 2D animation. By recording and converting human facial movements into digital data, this technology enables animators to create realistic and expressive characters, capturing micro-expressions such as eye and lip movements (Sijabat, 2019).

The integration of facial motion capture in 2D animation offers several advantages, including the ability to convey deeper emotional nuances and produce smoother, more lifelike movements. These qualities are particularly beneficial in educational or social awareness campaigns, where engaging and expressive animations can significantly enhance message delivery (Suryani, 2019). Additionally, combining motion capture techniques with pose-to-pose animation methods results in dynamic and visually compelling content (Bernadhed et al., 2019).

This study aims to explore the potential of facial motion capture technology in the development of a 2D animation themed around lateral thinking. Specifically, it seeks to achieve the following objectives to evaluate the effectiveness of facial motion capture in streamlining animation production while maintaining high-quality visuals and emotional depth.

DOI: https://doi.org/10.17509/edsence.v6i2.75582
p-ISSN:2685-2489 | e-ISSN:2685-2535

2. METHODOLOGY

This study employed a structured process consisting of three stages: pre-production, production, and post-production. The methodology was adapted from established animation design frameworks (Thifala, 2021). Each stage was carefully planned and executed to ensure the efficient integration of facial motion capture technology in creating a 2D animation themed around lateral thinking.

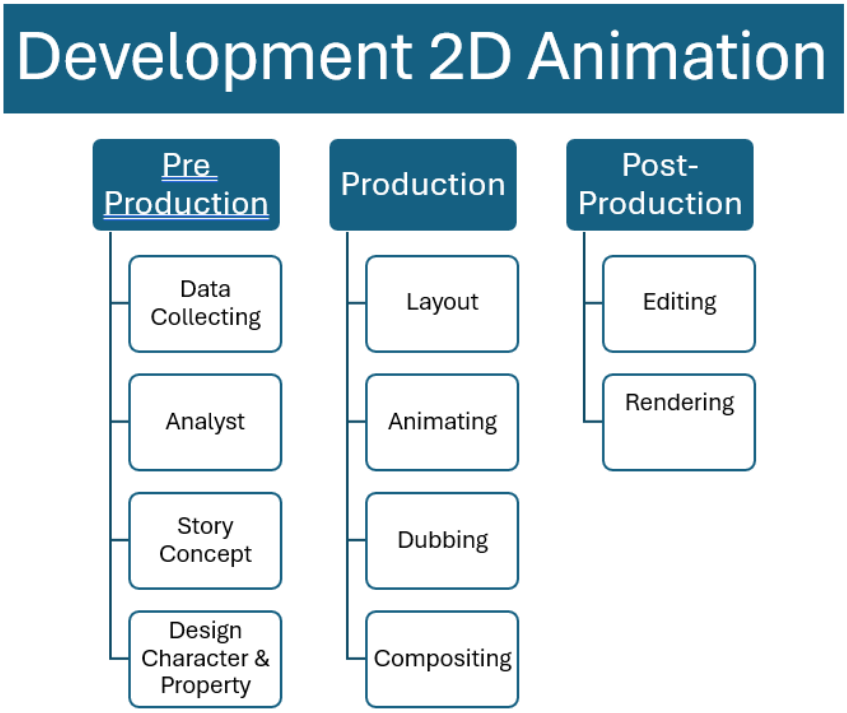

Figure 1. Methodology Development 2D Animation (Thifala, 2021)

- **Pre-production,** the pre-production phase began with data collection through a literature review of relevant studies on lateral thinking and animation as educational media. Insights were used to draft the narrative, design characters, and establish the animation's visual style. The main character, "Prof. Modo," a humanoid komodo dragon, was designed to resonate with the adolescent audience. Character sketches were developed using Adobe Illustrator, guided by mood boards inspired by works of Eduardo Bruks and Fabien Mense.
- **Production,** Facial motion capture technology was used to streamline the animation process and enhance character expressiveness. Human facial movements were recorded with Adobe Character Animator and applied to the digital character. Backgrounds were created in Adobe Photoshop, while audio synchronization and compositing were managed in Adobe After Effects 2022.
- **Post-Production,** In the post-production phase, the animation was refined through compositing and editing. Adobe Premiere Pro 2022 was used to finalize transitions, synchronize audio, and export the animation in high resolution.

DOI: https://doi.org/10.17509/edsence.v6i2.75582
p-ISSN:2685-2489 | e-ISSN:2685-2535

3. RESULTS AND DISCUSSION

The study developed a 2D animation titled Prof. Modo Explains Lateral Thinking, employing facial motion capture technology to enhance character expression and realism. The animation was structured into three segments: an introduction to creative index challenges, an explanation of lateral thinking concepts, and a discussion on factors that boost creative thinking. The final product was evaluated for its effectiveness in conveying the theme and engaging the audience

3.1. Pre-Production

The pre-production phase focused on gathering relevant data, developing the narrative, designing characters, and creating a storyboard. Data collection involved a comprehensive literature review of previous studies to establish the conceptual framework for the animation. Insights from these studies informed the development of a 2D animation suitable for conveying the concept of lateral thinking. There are three previous studies, summarized in the following table:

Tabel 1. Previous research

Research	Relevance to topic
Designing 2D Animated Explainer Videos for Raising Historical Awareness of Surabaya	Relevance: Explores the use of 2D animation for storytelling in historical contexts. Insight: Demonstrates the versatility of animation in presenting complex topics in an engaging manner.
Development of Flash Animation to Enhance Critical Thinking in Youth Against Hoaxes	Relevance: Highlights the role of animation in fostering critical thinking skills. Insight: Validates the effectiveness of animation in addressing abstract and cognitive topics.
Design of 2D Animation for Teaching Traditional Javanese Parikan Poetry	Relevance: Focuses on 2D animation as an educational tool for cultural preservation. Insight: Emphasizes the importance of cohesive character design and narrative structure

Based on the three previous studies, it was concluded that 2D animation is a suitable medium for delivering information, as evidenced by the diverse topics effectively presented using 2D animation.

The design of this 2D animation adopts an explainer concept, emphasizing a distinctive character: a humanoid komodo dragon capable of speaking as a narrator. This character, named Prof. Modo (an acronym for "Professor Komodo"), serves as the focal point of the animation. The animation employs a puppet animation style, enhanced with facial motion capture technology. Facial motion capture is a performance capture method that animates

DOI: https://doi.org/10.17509/edsence.v6i2.75582
p-ISSN:2685-2489 | e-ISSN:2685-2535

digital faces by recording human facial movements. This method adjusts keyframes to reflect a wide range of expressions, ensuring smooth and realistic motion quality (Bailey, 2022).

The animation conveys key messages, including the context of low creativity indices, the definition of lateral thinking, and its role as both a solution and a booster for fostering creativity. The visual style was developed using mood boards inspired by the works of Eduardo Bruks, Alex Kirtoon, Hugo Beaurepare, and Fabien Mense. Prof. Modo is depicted as a stylish and engaging character, carefully tailored to appeal to the target audience—young people.

Figure 2. Design character Profesor Modo

The narrative of the 2D animation themed around lateral thinking is divided into three segments. The first segment introduces and provides an overview of data related to the creativity index. The second segment focuses on explaining the concept of lateral thinking, while the third segment, serving as the conclusion, discusses factors that can support the development of creative thinking.

The audio production for this 2D animation was categorized as part of the pre-production phase, as it was completed prior to animating the character designs. This sequencing underscores the rationale for including audio production as an integral component of the pre-production process.

DOI: https://doi.org/10.17509/edsence.v6i2.75582
p-ISSN:2685-2489 | e-ISSN:2685-2535

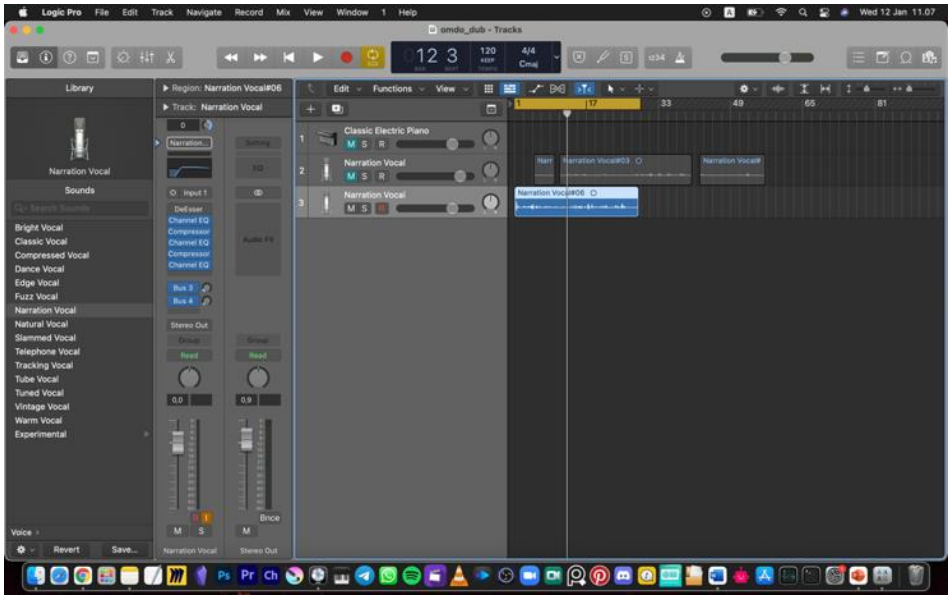

Figure 3. Preview Audio Production

3.2. Production

The production process consists of several stages, including layout design, animating (facial motion capture), voice dubbing, and compositing. The animation stage employs a facial rigging technique, commonly referred to as facial motion capture.

The layout process involves creating background designs and positioning characters, playing a crucial role in visually supporting the narrative and maintaining compositional balance (Ghertner, 2010).

The animating stage focuses on bringing characters to life. Facial motion capture is utilized during this phase to animate character faces by capturing and applying human facial movements, ensuring realistic and dynamic expressions.

Figure 4. Recording facial motion capture using Adobe Character Animator.

DOI: https://doi.org/10.17509/edsence.v6i2.75582
p-ISSN:2685-2489 | e-ISSN:2685-2535

3.3. Post-Production

The post-production phase focused on compositing and exporting processes. Text and illustration transitions were created using Adobe After Effects 2022, utilizing presets such as shift transition, align transition, and Animation Composer 3 (overshoot scale). Meanwhile, the compositing of visual and audio elements, as well as the final export, was completed using Adobe Premiere Pro 2022 to ensure a polished and cohesive final product.

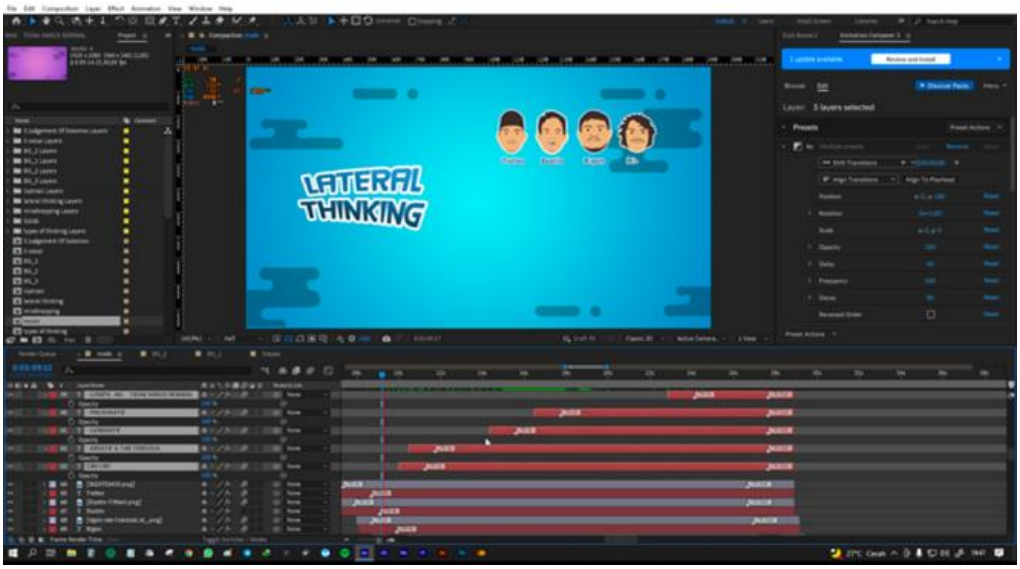

Figure 5. Compositing

The design output is an 8-minute 2D explainer animation divided into three segments. The first segment presents facts about the need for creativity and innovation in addressing the challenges of the modern world.

Figure 6. Animation section 1

DOI: https://doi.org/10.17509/edsence.v6i2.75582
p-ISSN:2685-2489 | e-ISSN:2685-2535

The second segment explains the concept of lateral thinking and includes a case study. The chosen example illustrates how Prophet Solomon applied lateral thinking in guiding his people.

Figure 7. Animation section 2

The third segment discusses factors that stimulate creativity. Illustrations are incorporated throughout this segment to enhance message delivery and support audience understanding.

Figure 8. Animation section 3.

DOI: https://doi.org/10.17509/edsence.v6i2.75582
p-ISSN:2685-2489 | e-ISSN:2685-2535

The evaluation was conducted using a questionnaire method. The questionnaire, administered via Google Forms, aimed to assess whether the animation's message and objectives were effectively conveyed to the audience. Additionally, it evaluated the audience's knowledge of lateral thinking before and after watching the animation.

The questionnaire was distributed in two phases: a pre-test and a post-test. The pre-test employed yes/no questions to gauge baseline knowledge, while the post-test used a 1–5 scale based on the System Usability Scale (SUS) methodology. The SUS scale was utilized to measure perceived usability through visual elements (Baumgartner, 2019).

The evaluation involved 25 respondents, each answering 10 questions rated on a 1–5 scale. Participants completed the questionnaire using a prepared Google Form. The following are the results obtained from the questionnaire.

Table 2. Questionnaire Result

No	Respondents	SUS Score Calculation										Sub Total	Point
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10		(Total x 2,5)
1.	Responden 1	4	4	4	4	3	4	4	4	4	4	39	97,5
2.	Responden 2	4	4	4	3	4	4	3	4	4	3	37	92,5
3.	Responden 3	3	3	4	3	4	3	3	4	4	3	34	85
4.	Responden 4	4	4	4	3	4	4	4	4	3	3	37	92,5
5.	Responden 5	4	4	4	4	4	4	4	3	3	4	38	95
6.	Responden 6	4	3	4	3	4	4	4	4	3	4	37	92,5
7.	Responden 7	4	4	4	3	3	3	4	4	4	4	37	92,5
8.	Responden 8	4	4	4	3	4	4	4	3	4	4	38	95
9.	Responden 9	3	3	4	3	4	4	3	4	2	4	34	85
10.	Responden 10	4	4	4	4	4	4	4	4	3	4	39	97,5
11.	Responden 11	4	3	3	4	4	3	3	4	3	2	33	82,5
12.	Responden 12	3	3	4	4	4	3	4	3	2	3	33	82,5
13.	Responden 13	3	3	4	3	3	4	3	3	2	4	32	80
14.	Responden 14	4	4	4	3	3	4	3	3	4	3	35	87,5
15.	Responden 15	4	3	3	4	4	3	4	4	4	4	37	92,5
16.	Responden 16	4	4	3	4	4	3	4	4	3	4	37	92,5
17.	Responden 17	4	3	3	4	4	3	4	4	3	4	36	90
18.	Responden 18	3	4	4	4	4	4	4	4	4	4	39	97,5
19.	Responden 19	4	4	4	3	4	4	4	4	3	4	38	95

DOI: https://doi.org/10.17509/edsence.v6i2.75582
p-ISSN:2685-2489 | e-ISSN:2685-2535

No	Respondents	SUS Score Calculation										Sub Total	Point
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10		(Total x 2,5)
20.	Responden 20	4	4	4	3	4	3	3	4	3	4	36	90
21.	Responden 21	4	4	4	4	3	4	4	4	4	4	39	97,5
22.	Responden 22	4	4	3	4	4	4	4	4	3	4	38	95
23.	Responden 23	4	4	4	4	4	3	4	4	4	4	39	97,5
24.	Responden 24	4	4	4	3	4	3	4	4	3	3	36	90
25.	Responden 25	4	3	4	4	4	4	4	4	3	4	38	95
Final Score													91,6

The evaluation results revealed an average final score of 91.6. This score is categorized as "Excellent" on a grading scale equivalent to an "A." Based on the data, the visual quality, audio, and comprehension of the video content were deemed acceptable and met the expected standard.

4. CONCLUSION

This study successfully developed a 2D animation utilizing motion capture technology as an educational medium to convey the concept of lateral thinking. The animation achieved a high System Usability Scale (SUS) score of 91.6%, demonstrating that users effectively understood its content. These findings indicate that the animation successfully introduced and enhanced comprehension of lateral thinking among respondents.

The visual and audio quality, particularly the character design of Prof. Modo, narrative illustrations, and 2D animation movements, were well-received by the audience. The creative elements in the animation significantly supported the delivery of its message, highlighting its ability to engage and educate effectively. Notably, respondents preferred animation as a learning medium over traditional educational materials, such as textbooks, underscoring its potential to innovate and increase motivation in educational contexts.

This research contributes to the field of educational technology by showcasing the integration of motion capture techniques into 2D animation, offering a novel approach to engaging learners with abstract concepts. The study highlights the applicability of such animations across various subjects, suggesting potential for use in STEM education, creative thinking workshops, and public awareness campaigns. Future research could expand on this work by exploring its impact on long-term learning outcomes, broader audience demographics, and interdisciplinary applications.

DOI: https://doi.org/10.17509/edsence.v6i2.75582
p-ISSN:2685-2489 | e-ISSN:2685-2535

AUTHORS' NOTE

Para penulis menyatakan bahwa tidak ada konflik kepentingan terkait dengan publikasi artikel ini. Para penulis juga mengonfirmasi bahwa artikel ini bebas dari plagiarisme.

REFERENCES

Azharina, S., Lestari, O. B., & Setyasih, D. (2022). Perancangan Video animasi 3D menggunakan teknologi motion capture tentang pengenalan teknik dasar Ilmu Beladiri Pecak Silat. *ICIT Journal*, *8*(2), 218–230. https://doi.org/10.33050/icit.v8i2.2411

Bailey, S. W., Riviere, J., Mikkelsen, M., & O'Brien, J. F. (2022). Monocular facial performance capture via deep expression matching. *Computer Graphics Forum*, *41*(8), 243–254. https://doi.org/10.1111/cgf.14639

Baumgartner, J., Frei, N., Kleinke, M., Sauer, J., & Sonderegger, A. (2019). Pictorial system usability scale (P-SUS). *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, 1–11. http://dx.doi.org/10.1145/3290605.3300299

Bernadhed, B., Affandi, Y., Nuryanto, N. S., Mahendra, E., & Setiawan, S. E. (2019). Implementasi Metode Pose to Pose dalam Pembuatan Animasi 2D Gerakan Ruku' Shalat. *Respati*, *14*(1). https://doi.org/10.35842/jtir.v14i1.265

Blakemore, S.-J. (2018). Avoiding social risk in adolescence. *Current Directions in Psychological Science*, *27*(2), 116–122. https://doi.org/10.1177/0963721417738144

Borzekowski, D. L. G. (2018). A quasi-experiment examining the impact of educational cartoons on Tanzanian children. *Journal of Applied Developmental Psychology*, *54*, 53–59. https://doi.org/10.1016/j.appdev.2017.11.007

Chatzitofis, A., Zarpalas, D., Kollias, S., & Daras, P. (2019). DeepMoCap: Deep optical motion capture using multiple depth sensors and retro-reflectors. *Sensors*, *19*(2), 282. https://doi.org/10.3390/s19020282

Fangming Dai, & Li, Z. (2024). Research on 2D animation simulation based on artificial intelligence and biomechanical modeling. *EAI Endorsed Transactions on Pervasive Health and Technology*, *10*. https://doi.org/10.4108/eetpht.10.5907

Mustofa, R. F., & Hidayah, Y. R. (2020). The effect of problem-based learning on lateral thinking skills. *International Journal of Instruction*, *13*(1), 463–474. https://doi.org/10.29333/iji.2020.13130a

Nursolehat, M., Rinjani, D., & Padmasari, A. C. (2024). Animasi 2D "Eksplorasi Profesi Bidang Teknologi" sebagai Media Edukasi Pengenalan Profesi pada Siswa Sekolah Dasar. *Journal of Animation and Games Studies*, *10*(2), 121–134. https://doi.org/10.24821/jags.v10i2.10909

Pichayapinyo, P., Sompopcharoen, M., Thiangtham, W., Sillabutra, J., Meekaew, P., Bureerat, B., & Somboonkaew, A. (2024). Perceptions of the 2D short animated videos for literacy against chronic diseases among adults with diabetes and/or hypertension: A

DOI: https://doi.org/10.17509/edsence.v6i2.75582
p-ISSN:2685-2489 | e-ISSN:2685-2535

qualitative study in primary care clinics. *BMC Primary Care*, *25*(1). https://doi.org/10.1186/s12875-024-02621-z

Sijabat, A. J. (2019). Motion Capture Dalam Penciptaan Gerak Natural Karakter Alita Dalam Film "Alita: Battle Angel." *Prosiding Seminar Nasional Cendekiawan*. https://doi.org/10.25105/semnas.v0i0.5816

Suliswaningsih, S., Achmad Masruri, Ganang Eko Saputro, Anugerah Bagus Wijaya, & Chyntia Raras Ajeng Widiawati. (2023). Animasi "keluarga aman" sebagai media sosialisasi pencegahan penularan COVID-19. *Infotekmesin*, *14*(1), 8–13. https://doi.org/10.35970/infotekmesin.v14i1.1484

Suryani, R., Saputra, H., & Sutrisman, A. (2019). Implementasi Animasi 2D pada Iklan Layanan Masyarakat sebagai Sosialisasi Penyakit DBD. *REKAM*, *15*(2), 153–166. https://doi.org/10.24821/rekam.v15i2.3330

Susila, A. (2023). Analisis system usability scale (sus) dan perancangan sistem self service pemesanan menu di restoran berbasis web. *Majalah Ilmiah UNIKOM*, *21*(1). https://doi.org/10.34010/miu.v21i1

Thifala, A. Z., Wardhana, M. I., & Sutrisno, A. (2021). Perancangan animasi 2D mengenai upaya pencegahan penyakit saat musim hujan. *JoLLA: Journal of Language, Literature, and Arts*, *1*(7), 995–1009. https://doi.org/10.17977/um064v1i72021p995-1009

Yang, Z. (2024). 2D animation comic character action generation technology based on biomechanics simulation and artificial intelligence. *Molecular & Cellular Biomechanics*, *21*(1), 338. https://doi.org/10.62617/mcb.v21i1.338

DOI: https://doi.org/10.17509/edsence.v6i2.75582
p-ISSN:2685-2489 | e-ISSN:2685-2535