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The impact of interactive multimedia on young learners' achievement and academic behaviour in the classroom in the context of student-centred learning

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Abstract. This era is characterized by the extensive use of technology tools, particularly in education. In this study, we evaluated young learners' academic achievement and academic behaviour degree in the classroom using interactive multimedia tools such as Canva, Powtoon, and learning games. The study utilized a mixed-method approach, including a pre- and post-test to assess achievement and a questionnaire to evaluate the academic behaviour of learners. This study examined whether there was a significant difference between the outcomes of teaching through interactive multimedia learning materials and the academic behaviour of learners after the intervention. The sample consisted of 35 primary-level students (ages 8 to 9) from Midad Private School. The collected data were analyzed using SPSS version 26, employing t-tests, means, and standard deviations. The results show that interactive multimedia tools, such as Canva, Powtoon, and educational games, are able to make a significant impact on the education process. These tools effectively improve young learners' academic achievement, as evidenced by significant improvements in post-test scores compared to pre-test scores. Furthermore, interactive multimedia enhances cognitive engagement and self-regulation among students. Study recommendations focused on the importance of using multimedia tools and training teachers to use ICT in education.

Keywords: interactive multimedia, achievement, academic behaviour, student-centred learning, primary school cycle

1. Introduction

In recent years, the integration of interactive multimedia in educational settings has transformed traditional teaching methods, fostering a more dynamic and engaging learning environment. This approach combines a variety of media forms, including text, audio, video, images, and animations, to create immersive learning experiences that actively involve students in the learning process. Researchers in the fields of information technology and education technology continue to study how multimedia technologies can enhance teaching and learning [3]. There are many ways to expand teaching and learning through software. The majority of learning fields require students to gain practical experience [1]. Moreover, Wulandari et al. [23] found that interactive multimedia can assist learners in better retaining and understanding the information they are learning. According to Adeyele [2], multimedia designed for learning refers to a variety of activities involving the construction of mental representations based on words and pictures in diverse contexts. These multimedia elements allow complex concepts to be presented in clear and accessible formats [21], catering to the diverse learning styles of students. Multimedia extends beyond text

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and graphics to include sound, animation, video, and interaction [4, 7, 18]. Several types of multimedia tools can be used in the classroom, such as audio narration, pictures, videos, animations, or combinations of these media, to enhance teaching effectiveness [11, 12]. For example, images, animations, or text explanations can be utilized during lessons. To make learning an enjoyable and effective experience, interactive multimedia captures students' interest and encourages active participation. Teachers can create a stimulating atmosphere by incorporating elements such as animations, interactive quizzes, and similar features to engage students more deeply with the content [13]. Furthermore, Wulandari et al. [23] and Leow and Neo [13] found that students can navigate interactive multimedia content at their own pace, allowing for personalized learning. This flexibility supports self-directed learning and accommodates varying levels of prior knowledge among students.

On the other hand, by offering a fun and interactive learning environment, multimedia helps learners better understand complex scientific concepts [2]. According to Chen [4] and Guan, Song and Li [7], the use of multimedia often aids comprehension and memorization of information. Similarly, Idris and Abubakar [8] found that students taught "Introduction to Computer Studies" using interactive multimedia instruction outperformed those taught using the conventional lecture method. Nowadays, various forms of multimedia are available and can be used to present lessons in ways that suit learners' needs. The effectiveness of multimedia as a teaching and learning tool has been proven in numerous studies. However, few studies have focused on the academic behaviour of primary learners regarding the use of multimedia in practical learning environments.

This study explores two dimensions: first, the implementation of multimedia to improve students' learning achievements by helping them master competencies across various grades and contexts (e.g., in Algeria). Second, the study examines the academic behaviour of learners after the multimedia experience, placing them at the centre of the learning process. Combining these two dimensions allows learners to actively participate in the teaching and learning process in primary schools and select educational tools tailored to their needs.

The research's problem was to examine the impact of interactive multimedia learning materials such as Canvas, Powtoon, and game programs on the academic achievement of young learners (3rd grade) in primary schools. We also want to know if interactive multimedia tools affect young learners' academic behaviour.

2. Research hypotheses

According to the problem statement, the research hypotheses are as follows:

- There are no significant differences in pre- and post-tests for teaching using interactive multimedia learning materials using Canva, Powtoon, and a game program.
- There is no relationship between teaching through interactive multimedia and learners' academic behaviour in the classroom.

3. Student-centered learning

According to Coleman et al. [5], when ICT is used effectively, it transforms the learning environment from teacher-centered to learner-centered. *The student-centred approach is a teaching and learning method that places the needs and interests of students at the centre of the educational process. It emphasizes engagement, collaboration, and student autonomy, aiming to create a learning environment that supports, challenges, and aligns with students' needs and goals* [9, p. 2]. In this approach,

students are at the centre of the learning process, and the focus shifts from traditional teacher-led instruction to student-led learning. Within this method, multimedia resources play a significant role in enhancing the learning experience, as they offer a wide range of advantages aligned with these principles, which can enhance the effectiveness of multimedia tools in educational settings. Various learning styles and preferences can be addressed with multimedia tools, such as videos, animations, and interactive simulations. Mayer [14, p. 2] defined multimedia learning as "*building mental representations from words and pictures*". In addition to providing students with the option to interact with content in a variety of formats, these tools also increase engagement and motivation among learners.

Students in a student-centred learning (SCL) environment are encouraged to explore materials at their own pace. This autonomy enables them to take ownership of their education [10]. As a result, students often become more engaged in the learning process, increasing their interest and investment. Multimedia tools allow students to customize their learning experiences by choosing how to engage with content. They can revisit materials, adjust their pace of learning, and select resources that meet their individual needs [9, 22]. This flexibility enables students to learn in ways that suit their requirements, regardless of their prior knowledge. Through exploration and interaction with multimedia content, students construct their own knowledge rather than passively receiving information [13, 22]. The interactive nature of multimedia promotes critical thinking and problem-solving skills, two essential components of effective learning. In SCL environments, the use of multimedia also fosters peer collaboration and encourages active participation. It often enhances communication skills and teamwork by supporting group work, discussions, and shared projects [9]. Students benefit from this collaborative aspect, as it not only enriches their learning experience but also prepares them for real-world interactions that require teamwork.

Teachers need to understand how multimedia and student-centered approaches work together to develop effective educational strategies. As educators continue to integrate these tools into their teaching practices, these strategies must address the diverse needs of learners.

4. Research methods

4.1. Data collection and sample

In this study, we used a pre-test-post-test quasi-experimental design to examine the impact of interactive multimedia on young learners' achievement, as well as a questionnaire to assess their academic behaviour. By using this mixed-method approach, it was possible to evaluate the effects of the intervention on student's performance and behaviour. The sample consisted of 35 primary school students who were randomly selected from Midad Private School in Algeria. All research participants were from the same educational setting and were taught by the same teacher. To effectively integrate interactive multimedia into her teaching process, the teacher underwent a one-week training course. She was provided with the necessary resources and materials to implement the interactive multimedia and was given the opportunity to ask questions and receive feedback from the author. After completing the training, the teacher successfully incorporated interactive multimedia into her teaching process. Each lesson was designed by the author, with input from the teacher, before the course began to ensure the best-controlled conditions for the intervention.

During the period from 5 to 21 February 2024, six lessons were conducted in the classroom each week, which usually lasted 45 minutes. For the purpose of this study, we specifically designed the lessons for this experiment to teach the second and third unity (Vaccination and healthy food) utilizing a presentation that was presented in the

class using Canva, Powtoon and a game. Each unity starts with a scene that looks like the text in the book, but instead of just text, we used animated characters and effects like music and video in order to make it look like an animated book. A post-test questionnaire was given to each student at the end of the intervention, which they had to fill out themselves without any assistance from the teacher.

4.2. Instrument development

Two primary research instruments were utilized in this study. Students were given a pre-test and a post-test to measure their academic performance. The tests were designed to evaluate learning outcomes across relevant curriculum areas. To assess students' academic behaviour, a structured questionnaire was developed by the authors based on a literature review and administered after the interactive multimedia intervention. The items were designed to capture two dimensions of academic behaviour:

- **Cognitive engagement**: this dimension consisted of six Likert-scaled items (four-point scale: Rarely to Constantly) that asked learners to identify behaviours related to understanding, learning, and problem-solving.
- **Self-regulation**: this dimension also consisted of six Likert-scaled items (four-point scale: Rarely to Constantly) that asked learners to identify behaviours related to emotional control, motivation, and the ability to manage learning activities independently.

A content validity assessment was conducted with (2 experts) and (3 primary school teachers). The reviewers individually marked unclear information in the questionnaire. Their feedback was used to refine and modify the questionnaire. Furthermore, a reliability test was conducted with 30 primary school learners.

4.3. Reliability

SPSS v26 was used to calculate Cronbach's alpha to determine the reliability of the questionnaire. For the first dimension (6 items) of the questionnaire, Cronbach's alpha is 0.902, and for the second dimension (6 items), it is 0.770.

5. Results

Statistical methods were used to analyze quantitative data as follows: comparing pre-test and post-test scores with paired samples t-tests; descriptive statistical analysis as mean, percentage and standard deviation by (SPSS v26) to evaluate academic behaviour; significance level set at $p < 0.05$ to ensure statistical reliability.

5.1. Analysis of the differences between the post-test and pre-test

The results of statistical analysis in table 1 present the mean scores of post-tests and pre-tests (8.37, 7.02). It indicates that it has different mean scores.

Table 1
Paired samples statistics.

		Mean	*N*	Standard deviation	Standard error of the mean
Pair 1	Post-test	8.3786	35	1.29247	0.21847
	Pre-test	7.0286	35	1.50461	0.25433

The results show that the correlation score between the post-test and pre-test is 0.826. This correlation is based on a sample size of 35 participants and has a significance value of 0.000.

The results of the statistical analysis from a paired sample t-test compare the post-test and pre-test scores. The t-test value is 9.404, with 34 degrees of freedom (df) and a p-value of 0.000. The mean difference between the post-test and pre-test is 1.35000, with a standard deviation of 0.84931 and a standard error of the mean of 0.14356. The 95% confidence interval of the difference ranges from 1.05825 to 1.64175. Since the t-value of 9.404 corresponds to a p-value less than 0.000, it is concluded that the post-test results are significantly different from the pre-test results.

5.2. Academic behaviour of learners after the experience

Table 2 shows responses from 35 students (*N*=35) regarding their learning behaviours after using multimedia tool teaching methods. The highest individual mean scores are for "I focus on learning new information" (3.5556), "I concentrate on solving problems for enough timeframe" (3.3333), "I strive hard to complete tasks" (3.2778), "I depend on myself to complete applications"(3.2500), while the lowest mean scores are for "I listen to the teacher when she explains" (2.4167), "I ask for clarification when I don't understand" (2.3056). Other items are within the average.

Based on the relatively low standard deviations (mainly 0.6-0.9), responses appeared to be fairly consistent across the sample.

Table 2
Learners academic behaviour after using multimedia.

The new teaching method makes me	*N*	Mean	Standard deviation	Variance
I listen to the teacher when she explains.	35	**2.4167**	0.96732	0.936
I ask for clarification when I don't understand.	35	**2.3056**	0.88864	0.790
I focus for long enough periods of time to complete what is required.	35	3.2222	0.79682	0.635
I understand my role in completing educational activities.	35	3.0556	0.75383	0.568
I am easily distracted. [*N*]	35	3.0278	0.81015	0.656
I work with or without a teacher.	35	3.0556	0.71492	0.511
I focus on learning new information.	35	**3.5556**	0.73463	0.540
I depend on myself to complete applications.	35	**3.2500**	0.64918	0.421
I strive hard to complete tasks.	35	**3.2778**	0.77868	0.606
I keep working until the learning goal is achieved.	35	3.1111	0.74748	0.559
I continue trying to find a solution to the problem.	35	3.0278	0.87786	0.771
I concentrate on solving problems for enough timeframe.	35	**3.3333**	0.86189	0.743
Cognitive engagement	35	17.1389	3.78080	14.294
Self-regulation	35	19.5000	2.98089	8.886
Valid *N* [listwise]	35			

The average behaviour scores were calculated based on the arithmetic mean: 1 to 2.49 indicates low behaviour scores, 2.50 to 3.24 indicates average behaviour scores and 3.25 to 4 indicates high behaviour scores.

6. Discussion

According to the results of this study, the use of interactive multimedia tools in a student-centred learning environment has a significant impact on both academic achievement and behavioural engagement among primary school learners. The results indicate that post-test scores were substantially higher than pre-test scores, suggesting that interactive multimedia can effectively assist in the acquisition of knowledge

and the development of skills. Similar results were reached in earlier research by Berk [3] and Abdulrahaman et al. [1], which highlighted the benefits of multimedia in creating engaging and effective learning environments. Interactive multimedia provides multisensory learning experiences through the integration of text, audio, video, and animations, which is particularly beneficial for young learners who often have diverse learning styles and preferences [14].

Firstly, the findings of this study align with prior research that has emphasized the advantages of using interactive multimedia in education. According to Berk [3], multimedia tools create immersive learning experiences by incorporating text, images, video, and animations. Similarly, Wulandari et al. [23] and Mayer [14] found that multimedia enhances information retention and understanding, particularly when designed to accommodate various learning styles. This study further demonstrates that multimedia supports self-paced and self-directed learning, consistent with findings by Tuhuteru et al. [22] and Leow and Neo [13], which show that multimedia is highly adaptable in student-centred learning environments.

Furthermore, Adeyele [2] asserts that multimedia tools simplify complex concepts, making them understandable for learners of varying abilities, regardless of their backgrounds. This study confirms these assertions by demonstrating that multimedia tools enhanced students' problem-solving abilities and task-completion skills. Additionally, the results highlight that multimedia plays an important role in encouraging learners to engage in cognitive domains by keeping them interested and engaged throughout the learning process. Learners in primary school often have shorter attention spans, so traditional teaching methods may not be effective. However, interactive multimedia stimulates curiosity and motivation with dynamic and visually appealing content. The use of Powtoon and educational games allows young learners to explore concepts in a hands-on way, making abstract ideas more concrete and understandable. By actively participating, learners are required to analyze, synthesize, and apply information rather than passively receiving it [14]. According to Kerimbayev et al. [9] and Tuhuteru et al. [22], autonomy and ownership are crucial aspects of student-centred learning. A significant finding of this study is the higher level of self-regulation demonstrated by learners, attributed to the interactive and flexible nature of the multimedia tools. Canva and Powtoon allow learners to self-regulate by providing them with immediate feedback and adaptive learning paths. As a result of this personalized approach, learners are able to monitor their progress and improve self-regulation skills since they feel more autonomous and competent. Moreover, interactive multimedia is a powerful learning tool that promotes collaboration. Through these social interactions, learners become more adept at regulating their behaviour and communication in group settings [6]. By using these tools, learners were able to explore materials at their own pace, revisit content, and practice skills as needed, fostering independence and motivation. Interestingly, the first item, "I listen to the teacher when she explains", can be interpreted using Mayer's [15] theory of the "split attention effect." According to this theory, students experience cognitive overload when they have to divide their attention between multiple sources of information, such as multimedia tools and teacher explanations presented simultaneously. This may explain why young learners in this study paid less attention to teacher explanations when multimedia was present.

Secondly, while this study aligns with much of the existing literature, it also provides unique contributions and highlights specific differences. Notably, this study focuses on primary school students – a demographic often overlooked in studies on interactive multimedia. Most prior research, such as that by Idris and Abubakar [8], has focused on older students or higher education contexts. By addressing this critical gap, the study demonstrates that multimedia tools are equally effective in teaching foundational skills to children. Additionally, the dual focus on academic

achievement and behavioural outcomes is a distinguishing feature of this study. While many existing studies emphasize cognitive gains such as improved retention and comprehension [7, 14], fewer explore the behavioural dimensions of learning, such as self-regulation and cognitive engagement, particularly in primary schools. This study provides empirical evidence that interactive multimedia can positively influence these behavioural dimensions, fostering a holistic approach to student development. However, despite significant improvements in areas like problem-solving and task completion, some dimensions of academic behaviour showed only modest gains. For instance, the relatively lower scores for asking for clarification suggest that while multimedia fosters independence, it may not fully address collaborative or communicative skills. This contrasts with findings by Kerimbayev et al. [9], which highlight the collaborative potential of multimedia tools in higher education. This discrepancy may be attributed to the younger age group in this study, as younger learners may require more scaffolding to develop these skills effectively.

Thirdly, the results have significant implications for educational practice, especially within primary education, which is the focus of this study. The positive outcomes observed suggest that integrating interactive multimedia into classrooms can improve both academic performance and student engagement at a behavioural level. However, the study also emphasizes the importance of a balanced approach. While multimedia tools promote independence and engagement, their full potential can only be realized when combined with teacher facilitation and support. Teachers play a critical role in guiding students in the effective use of multimedia tools, particularly in areas where young learners may struggle, such as communication and collaboration [16, 17]. Finally, teachers should participate in professional development programs, such as the one provided in this study, to acquire the necessary skills and knowledge for integrating these tools effectively, as suggested by Rzońca [19] and Semerikov, Striuk and Shalatska [20]. Additionally, to maximize the impact of multimedia content, it must be tailored to align with curriculum objectives and student needs.

7. Conclusions and prospects for further research

In conclusion, this study demonstrated that interactive multimedia tools have significant potential for enhancing both academic achievement and behavioural engagement among primary school learners. These tools contribute to the creation of more effective and engaging educational environments by fostering the development of independence, motivation, and active participation among students, aligning with the principles of student-centred learning. To realize their full potential, these tools must be implemented carefully, ongoing teacher support must be provided, and a balanced approach must be adopted to address both the individual and collaborative learning needs of students. Furthermore, this study adds to the discussion about integrating technology into education through a student-centred learning framework. The findings support the growing consensus that multimedia tools can enhance traditional teaching methods by creating more dynamic and interactive learning environments. However, the study also raises questions about the long-term effects of these tools on student behaviour. Future research could explore these dimensions further by examining how the sustained use of multimedia influences academic achievement and behavioural development. Educators and policymakers might also benefit from investigating how multimedia can enhance higher-order skills such as critical thinking and creativity.

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References

[1] Abdulrahaman, M.D., Faruk, N., Oloyede, A.A., Surajudeen-Bakinde, N.T., Olawoyin, L.A., Mejabi, O.V., Imam-Fulani, Y.O., Fahm, A.O. and Azeez, A.L., 2020. Multimedia tools in the teaching and learning processes: A systematic review. *Heliyon*, 6(11), p.e05312. Available from: https://doi.org/10.1016/j.heliyon.2020.e05312.

[2] Adeyele, V.O., 2024. Relative efectiveness of simulation games, blended learning, and interactive multimedia in basic science achievement of varying ability pupils. *Education and Information Technologies*, 29, pp.14451–14470. Available from: https://doi.org/10.1007/s10639-023-12414-z.

[3] Berk, R.A., 2009. Multimedia Teaching with Video Clips: TV, Movies, YouTube, and mtvU in the College Classroom. *International Journal of Technology in Teaching and Learning*, 5(1), pp.1–21. Available from: https://www.researchgate.net/publication/228349436.

[4] Chen, N., 2012. Autonomous Learning in the Context of Computer-based Multimedia College English Teaching and Learning. *Theory and Practice in Language Studies*, 2(12), pp.2541–2547. Available from: https://doi.org/10.4304/tpls.2.12.2541-2547.

[5] Coleman, L.O., Gibson, P., Cotten, S.R., Howell-Moroney, M. and Stringer, K., 2016. Integrating Computing Across the Curriculum: The Impact of Internal Barriers and Training Intensity on Computer Integration in the Elementary School Classroom. *Journal of Educational Computing Research*, 54(2), pp.275–294. Available from: https://doi.org/10.1177/0735633115616645.

[6] Dillenbourg, P., ed., 1999. *Collaborative Learning: Cognitive and Computational Approaches*. 2nd ed. Elsevier Science.

[7] Guan, N., Song, J. and Li, D., 2018. On the Advantages of Computer Multimedia-aided English Teaching. *Procedia Computer Science*, 131, pp.727–732. Recent Advancement in Information and Communication Technology. Available from: https://doi.org/10.1016/j.procs.2018.04.317.

[8] Idris, B.I. and Abubakar, A.U., 2023. Effects of Interactive Multimedia Instruction on Students' Academic Achievement and Retention in Computer Studies in Federal College of Education, Zaria. *Sapientia Foundation Journal of Education, Sciences and Gender Studies*, 5(2), pp.327–334. Available from: https://www.sfjesgs.com/index.php/SFJESGS/article/view/429.

[9] Kerimbayev, N., Umirzakova, Z., Shadiev, R. and Jotsov, V., 2023. A student-centered approach using modern technologies in distance learning: a systematic review of the literature. *Smart Learning Environments*, 10(1), p.61. Available from: https://doi.org/10.1186/s40561-023-00280-8.

[10] Kiat, T.Y., Jumintono, J., Kriswanto, E.S., Sugiri, S., Handayani, E., Anggarini, Y. and Rofik, M., 2020. The Effectiveness of Multimedia Learning on Academic Achievement in Reproduction Topic Science Subject. *Universal Journal of Educational Research*, 8(8), p.3625–3629. Available from: https://doi.org/10.13189/ujer.2020.080839.

[11] Kumar, S.N., Lenin Fred, A., Padmanabhan, P., Gulyas, B., Dyson, C., Melba Kani, R. and Ajay Kumar, H., 2021. Multimedia-Based Learning Tools and Its Scope, Applications for Virtual Learning Environment. In: A. Deyasi, S. Mukherjee, A. Mukherjee, A.K. Bhattacharjee and A. Mondal, eds. *Computational Intelligence in Digital Pedagogy*. Singapore: Springer Singapore, *Intelligent Systems Reference Library*, vol. 197, pp.47–63. Available from: https://doi.org/10.1007/978-981-15-8744-3_3.

[12] Kuswanto, J., Yunarti, Y., Lastri, N., Dapiokta, J. and Adesti, A., 2021. Devel-

opment Learning Media Based Android for English Subjects. *Journal of Physics: Conference Series*, 1779(1), p.012020. Available from: https://doi.org/10.1088/1742-6596/1779/1/012020.

[13] Leow, F.T. and Neo, M., 2014. Interactive multimedia learning: innovating classroom education in a Malaysian university. *TOJET: The Turkish Online Journal of Educational Technology*, 13(2), pp.99–110. Available from: https://eric.ed.gov/?id=EJ1022913.

[14] Mayer, R.E., 2014. Introduction to Multimedia Learning. In: R.E. Mayer, ed. *The Cambridge Handbook of Multimedia Learning*. Cambridge University Press, Cambridge Handbooks in Psychology, pp.1–24. Available from: https://doi.org/10.1017/CBO9781139547369.002.

[15] Mayer, R.E., 2024. The Past, Present, and Future of the Cognitive Theory of Multimedia Learning. *Educational Psychology Review*, 36(1), p.8. Available from: https://doi.org/10.1007/s10648-023-09842-1.

[16] Meziane Cherif, K., Azzouz, L. and Bendania, A., 2024. Algerian secondary school students' preferences for the use of YouTube in their informal learning. *Educational Technology Quarterly*, 2024(2), p.120–134. Available from: https://doi.org/10.55056/etq.697.

[17] Meziane Cherif, K., Azzouz, L., Bendania, A. and Djaballah, S., 2024. The teachers' ban or permission of smartphone use in Algerian secondary school classrooms. *Educational Dimension*, 11, p.176–192. Available from: https://doi.org/10.55056/ed.727.

[18] Mursid, R., Saragih, A.H. and Simbolon, N., 2019. The Effect of Interactive Multimedia Based Learning Model with 4C Integrated and HOTS on Learning Results Instructional System Design (ISD). *Proceedings of The 5th Annual International Seminar on Trends in Science and Science Education, AISTSSE 2018, 18-19 October 2018, Medan, Indonesia*. EAI. Available from: https://doi.org/10.4108/eai.18-10-2018.2287393.

[19] Rzońca, E., 2024. Comparative analysis of the level of digital competences of future teachers in Poland and Ukraine. *Information Technologies and Learning Tools*, 104(6), p.81–95. Available from: https://doi.org/10.33407/itlt.v104i6.5826.

[20] Semerikov, S.O., Striuk, A.M. and Shalatska, H.M., 2021. AI-assisted language education: critical review. *Educational Dimension*, 4, p.1–7. Available from: https://doi.org/10.31812/ed.623.

[21] Suhairi, M., Asmawi, M., Tangkudung, J., Hanif, A.S. and Dlis, F., 2020. Development of SMASH Skills Training Model on Volleyball Based on Interactive Multimedia. *International Journal of Interactive Mobile Technologies (iJIM)*, 14(06), p.53–66. Available from: https://doi.org/10.3991/ijim.v14i06.13405.

[22] Tuhuteru, L., Misnawati, D., Aslan, Taufiqoh, Z. and Imelda, 2023. The Effectiveness of Multimedia-Based Learning To Accelerate Learning After The Pandemic At The Basic Education Level. *Tafkir: Interdisciplinary Journal of Islamic Education*, 4(1), p.128–141. Available from: https://doi.org/10.31538/tijie.v4i1.311.

[23] Wulandari, S.S., Puspasari, D., Puspasari, D., Wulandari, R.N.A. and Puspitasari, R.O., 2022. Development of interactive multimedia-based teaching materials for distance learning during the COVID-19 pandemic. *Jurnal Pendidikan Ilmu Sosial*, 32(2), pp.1412–3835. Available from: https://journals.ums.ac.id/jpis/article/view/19848.