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Android Based Multimedia for Teaching Science in Junior High School

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Abstract – *The COVID-19 pandemic has profoundly transformed global education, necessitating adaptive learning strategies to overcome the challenges of remote science instruction. This study aimed to develop and evaluate Android-based interactive multimedia using Adobe Flash CS for science learning, particularly human excretory system material, at Sukamaju State Junior High School 1. The research employed a Research and Development (R&D) approach based on the ADDIE model, comprising analysis, design, development, implementation, and evaluation stages. The study involved 27 students from class VIII, selected through simple random sampling. Data were collected using expert validation sheets, teacher and student response questionnaires, and student learning outcomes assessments. The results indicated that the developed multimedia met all quality standards: media expert validation (98.5%), material validation (97%), language validation (86%), and video content validation (92%), all categorized as "very valid." In terms of practicality, teacher and student responses yielded scores of 98% and 84.2%, respectively, indicating high practicality. Regarding effectiveness, student learning outcomes averaged 87.23%, and class completeness reached 81.4%, both falling into the "very effective" category. These findings demonstrate that Android-based science multimedia significantly enhances student engagement and learning outcomes by offering visually rich, interactive, and flexible educational content. The multimedia enables autonomous learning and supports teachers in delivering effective science instruction. Future research is recommended to broaden the content coverage across subjects and to develop applications compatible with online platforms for wider accessibility.*

Keywords: *adobe flash cs; android; multimedia; online learning*

I. INTRODUCTION

The rapid advancement of science and technology has significantly influenced various sectors, particularly education. Such progress has reshaped the utilization of educational media across schools. According to Sanaky (2009), the educational paradigm has shifted in response to the integration of information technology with school-based learning. The evolution of learning media from printed books to radio and television broadcasts has expanded the accessibility and diversity of educational tools. Learning media are inherently adaptable, continuously evolving alongside technological innovations in the digital era. Hence, the potential of media in learning must not be overlooked. Students and educators are expected to remain aligned with technological trends to prevent educational stagnation (Aljanazrahet al., 2022; Bonfield, 2020).

The COVID-19 pandemic profoundly affected the global education system, disrupting routine school activities and prompting a rapid shift in instructional strategies. Qualitative studies revealed that teaching science during the pandemic required distinct competencies and pedagogical practices to optimize available digital learning resources (Fontila et al., 2022; Boltsi, 2024). One major consequence was the emergence of blended learning systems, integrating online platforms and traditional classroom methods. Several factors influence the effectiveness of science instruction, including subject-matter expertise, pedagogical competence, student understanding, institutional support, digital literacy, teacher communication skills, continuous professional development, and quality of instructional materials. Science educators emphasized that effective teaching should link scientific concepts with real-life applications. The pandemic has underscored the necessity of flexible learning tools in science education. Instructional resources also play a critical role in determining the success of science teaching. However, studies found no significant differences in teachers' perceptions across demographic profiles regarding factors affecting science instruction. Given the positive correlations among these pedagogical factors, science teachers are encouraged to focus on adaptive strategies and methods during health crises such as COVID-19. Workshops and training programs aimed at deepening content mastery are essential to support effective science instruction during such disruptions. Future studies are recommended to explore other contributing factors that influence the quality of science education during and after global disruptions (Fontila et al., 2022; Mujiono & Gazali, 2020).

Media development has driven several key revolutions in education. These include the shift from parental instruction to formal teaching, the adoption of language and writing, and most recently, the integration of digital media. In this context, the use of educational media in schools has become indispensable. However, many schools still underutilize the potential of modern media in supporting teaching and learning processes (Alodan, 2021; García-Morales et al., 2021; Said et al., 2021). Innovations in learning media continue to evolve to meet students’ learning needs and align with technological trends. Students particularly require engaging, creative, and user-friendly learning resources that support comprehension and motivation.

A post-test assessment revealed that 87.88% of students successfully completed tasks using a mobile learning application. Experts also validated the authenticity and relevance of the mobile application's content, supporting its use in learning environments (Ciampa, 2013; Kurniawan et al., 2019; Hirsh-Pasek et al., 2015). Mobile devices facilitate flexible learning, enabling students to access materials anytime and anywhere, both within and beyond the classroom. In addition, teachers benefit from enhanced monitoring capabilities of student engagement and performance. Observations at the technical management unit of Sukamaju State Junior High School 1 revealed limited use of innovative learning media, resulting in low student interest and motivation, particularly in science, which students often perceive as challenging. Conventional media such as textbooks, anatomical models, and illustrations are still predominantly used. Such static media often fail to engage students, leading to passive classroom environments and reduced enthusiasm. Interviews with science teachers confirmed that the absence of creative, interactive media has hindered student engagement and curiosity. This issue is largely attributed to teachers' limited time, lack of experience, and inadequate training in developing multimedia-based content. Consequently, the lack of media variety has contributed to declining interest, reduced motivation, and poor learning outcomes, as reflected in students' daily assessments. These challenges inspired the researchers to develop multimedia-based learning materials using Adobe Flash CS. Adobe Flash CS was chosen for its capability to create dynamic animations, interactive visuals, and engaging learning interfaces. The developed multimedia is expected to enhance students' motivation and foster more productive science learning (Chen, 2020; Areed et al., 2021; Ningsih & Adesti, 2020; Komalawardhana & Panjaburee, 2024).

Interactive multimedia games have been shown to boost student motivation. Undergraduate trials indicated a strong preference for using such games as supplementary learning tools (Arirang et al., 2021; Chappel & Paliwal, 2014; Júnior et al., 2021; Dermentzi, 2023). Therefore, this study developed Android-based multimedia to enhance students' motivation to learn science. The objective of this research was to design and evaluate interactive multimedia to support science learning, particularly in online settings at the technical management unit of Sukamaju State Junior High School 1. The research focused on assessing the validity, practicality, and effectiveness of the developed Android-based science multimedia through appropriate empirical measures.

II. METHODS

The sample for this study consisted of 27 eighth-grade students from the Technical Management Unit at State Junior High School 1 Sukamaju. This research aimed to develop a multimedia learning product based on Adobe CS Flash. The study employed the ADDIE research and development model, which presents a structured and systematic framework for achieving effective instructional product outcomes. As each stage in the ADDIE model is interrelated, implementation must be sequential and comprehensive to ensure that the final product is both innovative and functional. The interdependency of the ADDIE stages supports the development of high-quality learning media (Kurt, 2017). The ADDIE stages consist of Analysis, Design, Development, Implementation, and Evaluation:

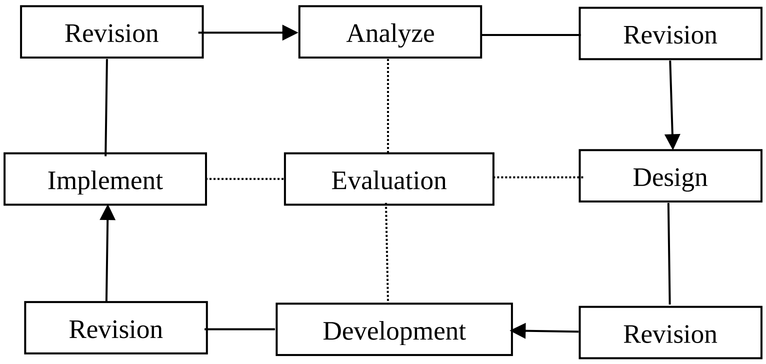

Figure 1. Stages of ADDIE development research

The quality of the developed Android-based science multimedia was evaluated through validity, practicality, and effectiveness testing using expert validation and user feedback.

1. Validity Test

Validation was carried out by experts who completed assessment questionnaires, which were then analyzed using quantitative methods. A Likert scale was used to quantify validation responses. Scores were interpreted on a five-point Likert scale: 5 (very valid), 4 (valid), 3 (fairly valid), 2 (invalid), and 1 (very invalid). The average score of each indicator was calculated to determine the level of validity. Validity was calculated using the formula:

$$V - ah = \frac{Tse}{Tsh} x100\%$$ (Sugiyono, 2017)

Description:
V-ah = Expert validity
Tse = Total empirical score of the validator
Tsh = Expected maximum score

After calculating average scores, validation results were translated into product feasibility criteria. The following Table 1 shows the translation of scores into the requirements for this assessment that was adopted from Agustina and Hajar (2024) and Amanullah and Wiharja (2022).

Table 1. Evaluation criteria for Android-based multimedia

Score percentage (%)	Interpretation
81 – 100	Very valid
61 – 80	Valid
41 – 60	Fairly valid
21 – 40	Invalid
0 – 20	Very invalid

Based on the scoring interpretation above, development was concluded once the media met the minimum feasibility standards in terms of material relevance, technical quality, and usability.

2. Practicality Test

Practicality was assessed using teacher and student response questionnaires, employing a four-point Likert scale (4 = strongly agree, 3 = agree, 2 = disagree, 1 = strongly disagree). The practicality score was calculated using the following formula:

$$V - pg = \frac{Tse}{Tsh} x100\%$$ (Sugiyono, 2017)

Description:
V-pg = User Validity
Tse = Total score of the empirical validator
Tsh = Expected maximum score

The score interpretations for practicality are presented in Table 2.

Table 2. Criteria for assessing the practicality of multimedia based on Adobe CS Flash

Interval	Qualification
85.01% - 100%	Very practical
70.01% - 85.00%	Practical
50.01% - 70.00%	Less practical
01.00% - 50.00%	Impractical

Adopted from Agustina and Hajar (2024)

3. Effectiveness Test

Effectiveness was determined by analyzing students' performance on post-tests. Effectiveness was measured by comparing student learning outcomes against the Minimum Completeness Criteria score of 75 for science. Individual student scores were calculated using the following formula:

$$Final\ score = \frac{Number\ of\ students\ acquisition\ score}{Maximum\ Total\ Score} x100\%$$

Class effectiveness was then determined using Arikunto (2012) class completeness formula:

$$Completness = \frac{The\ number\ students\ who\ ontained\ \geq 75\%}{Total\ students} x100\%$$

The effectiveness percentage was then interpreted based on the criteria in Table 3.

Table 3. Criteria for evaluating the effectiveness of Android Based Multimedia

Achievement criteria	Interpretation
81% - 100%	Highly effective
61% - 80%	Effective
41% - 60%	Moderately effective
21% – 40%	Less effective
0% – 20%	Very less effective

Adopted from Agustina and Hajar (2024)

III. RESULTS AND DISCUSSION

The science multimedia learning media based on Adobe CS Flash developed for the human excretory system material, is an interactive and practical tool. Given current technological trends, the younger generation increasingly integrates digital media into their daily lives, showing a strong preference for educational tools accessed via laptops and smartphones. The development followed the ADDIE model by Branch (2009), which includes five stages: Analysis, Design, Development, Implementation, and Evaluation. Yunita et al. (2023) demonstrated alternative development models, such as the STAD-based approach and the Borg & Gall model consisting of 7 to 10 stages which can also be applied for developing science learning media using Adobe Flash CS5.

The developed natural science multimedia for excretory system content is based on interactive Adobe CS Flash design. The use of such electronic media is expected to improve student focus and engagement with the presented content. The validity of the media was assessed through expert evaluation. Several revisions were made following validator feedback. The validity of the Android-based science multimedia was evaluated across several aspects: media, material, video content, and language. The figures below illustrate the initial display of the learning media designed for the excretory system, which was implemented across four learning sessions.

(a) (b)

Figure 2. (a) Initial display of interactive learning media; (b) Initial display of interactive learning media

(a) (b)

Figure 3. (a) Students fill out a questionnaire; (b) Learning activities using interactive multimedia

Adobe Flash enables the creation of multimedia content, including animations, videos, text, charts, and sound. Its advantages include compact file size after publishing, support for interactive animations, and compatibility with multiple file formats. Adobe Flash provides a range of tools, effects, and interactive features for designing engaging educational multimedia content. The practicality test aimed to determine whether the developed interactive media was user-friendly and whether students could easily comprehend the language used. According to the results, the Android-based interactive media facilitated the teaching process, supported by integrated videos and student worksheets on the excretory system. Moreover, the media helped students enhance their concentration and memory retention.

The multimedia can also support students engaging in independent learning. Students are able to access and study the content at any time and place without direct teacher supervision. These findings align with previous studies (Arirang et al., 2021; Hashimi et al., 2019), which concluded that multimedia applications stimulate student creativity in both school and home environments. The experimental results at the Technical Management Unit of Sukamaju State Junior High School 1 support the viability of the developed product and can serve as a reference for future implementation. The feasibility of the Android-based science multimedia was determined through evaluations of its validity, practicality, and effectiveness.

1. Validation Test

The developed media was validated to determine its legitimacy and quality. Revisions were conducted based on validator feedback. Several validation stages were conducted during the development of the Android-based multimedia focused on the human excretory system. Validation involved media, material, video content, language, lesson plans, and student worksheets. Each component was assessed through a questionnaire comprising several indicators, completed by relevant expert validators. The following table displays the media expert validator's evaluation:

Table 4. Results of the validation of Android-based science multimedia expert

Aspect	Item quantity	Tse	Tsh	%	Criteria
Multimedia science based on Adobe CS flash	17	3.94	4	98.5	Very valid

Description:
Tse = Total score of the empirical validator
Tsh = Expected maximum score

The validation of this material was conducted by distributing a questionnaire to the validator. The material validation process involved an 18-question questionnaire covering various topics, which was completed by a subject matter expert. The table below presents the evaluation results provided by the material validator:

Table 5. Results of the validation of Android-based science multimedia material

Aspect	Item quantity	Tse	Tsh	%	Criteria
Multimedia science based on Adobe CS flash	18	3.88	4	97	Very valid

Description:
Tse = Total score of the empirical validator
Tsh = Expected maximum score

The videos that were made were validated by a validator using a video/video content validation questionnaire. The video validation process is completed by completing a questionnaire consisting of 16 assessment items, which a video/video content expert will fill in and complete. The assessment results from the Video/Video Content validator is shown are shown in the following table:

Table 6. Results of Android-Based science multimedia video validation

Aspect	Item quantity	Tse	Tsh	%	Criteria
Multimedia science based on Adobe CS flash	16	3.68	4	92	Very valid

Description:
Tse = Total score of the empirical validator
Tsh = Expected maximum score

The language validation is done was conducted by providing a questionnaire to the validator/linguist. The language validation process is completed by completing was carried out using an evaluation questionnaire covering each component of the assessment, consisting of nine questions that will be filled out, which were completed by a language expert validator. The assessment results from the language validator are show are shown in the following table:

Table 7. Results of Android-based science multimedia language validation

Aspect	Item quantity	Tse	Tsh	%	Criteria
Multimedia science based on Adobe CS flash	9	3.44	4	86	Very valid

Description:
Tse = Total score of the empirical validator
Tsh = Expected maximum score

The validity testing of the lesson plan and student worksheets is carried out before the lesson plan and student worksheets are used before being tested for feasibility was conducted prior to their implementation and feasibility testing. The validation of the lesson plan and student worksheets are completed by completing an assessment form that will be completed by the student worksheets. A lesson plan was performed using an assessment form completed by expert validators. The results of the validators' assessment of the student worksheets and lesson plan are presented in the following table:

Table 8. Results of learning instrument validation

Aspect	Item quantity	Tse	Tsh	%	Criteria
Multimedia science based on Adobe CS flash	9	3.44	4	86	Very valid

Description:
Tse = Total score of the empirical validator
Tsh = Expected maximum score

2. Practicality Test

The practicality assessment showed that the media was easy to use and featured language that students could easily understand. Adobe CS Flash-based interactive media helped teachers facilitate lessons using embedded videos and worksheets. It also helped improve student concentration and memory.

a. Teacher Responds Questionnaire

Teacher feedback was collected through a questionnaire designed to assess the practicality of Android-based multimedia, which can be shown in the table below:

Table 9. The results of the practical analysis of student's response questionnaire to abode CS Flash Based natural Science multimedia

Number of respondents	Number of question items	Tse	Tsh	%	Criteria
1	21	3.95	4	98	Very practical

Description:
Tse= Total validator empiric score
Tsh= Score maximum expected

On average, the teacher scored four on the teacher reaction questionnaire, which falls into the *very practical* category. This result indicates that the Android-based science multimedia, in terms of content, was relevant to the basic competencies, presented the material systematically, met student needs, was supported by illustrations of the human excretory system, and included examples in each section. In terms of appearance and technical features, the Android-based science multimedia was considered highly attractive. The background design was visually appealing, the video materials were clearly presented, and the text was legible for students. Additionally, the media included clear usage instructions, well-positioned and functional buttons, and, most importantly, easy to use.

b. Student Response Questionnaire

Student feedback was obtained through a questionnaire measuring the media's perceived usefulness. The following table displays the findings of the data recapitulation from student reaction surveys to science multimedia based on Android:

Table 10. The results of the practical analysis of the teacher's response questionnaire to the Abode CS Flash based natural science multimedia

Number of respondents	Number of question items	Tse	Tsh	%	Criteria
27	16	3.37	4	84.20	Practical

Description:
Tse = Total validator empiric score
Tsh = Score maximum expected

The analysis of student responses classified the multimedia as practical due to its structured presentation of excretory system content, the use of clear and student-friendly language, intuitive navigation, and visually engaging interface. The video materials were accessible for repeated playback, which enhanced student comprehension and supported ease of use.

3. Effectiveness Test

a. Value of Individual Students' Learning Outcomes

Student learning outcomes serve as a key indicator of a product's effectiveness. The post-test scores indicated improved student performance and validated the usefulness of the developed media. Based on the compiled data, the average score achieved by the students was 90. The total scores were analyzed to assess the effectiveness of the Adobe CS Flash-based science multimedia. The resulting effectiveness score was 87.23%, placing it in the 'very effective' category.

b. Grade Completeness Score

Effectiveness was further evaluated using the class completeness rate, benchmarked against the 75-point Minimum Completeness Criteria for science. The following table displays the findings of the student score recapitulation:

Table 11. The results of the recapitulation of the class completeness score

Number of Students	Number of students who got 75 Percentage (%)	Percentage %	Criteria
27	22	81.40	Very effective

Developed learning media are considered effective when they significantly improve student learning outcomes. The purpose of this assessment was to measure the extent to which multimedia enhanced student proficiency in mastering the content. The success of the Android-based science multimedia illustrates the potential of integrating educational media into learning activities to improve student skills and outcomes. Learning outcomes reflected students' ability to complete the required stages of the learning process. A 20-item multiple-choice test was used as the assessment instrument.

Students who scored equal to or above the Minimum Completeness Criteria (MCC) threshold of 75 were categorized as achieving learning completeness. For the human excretory system content, the MCC was set at a score of 75. Prior to the use of Adobe CS Flash-based multimedia, student outcomes were relatively low; however, post-implementation, there was a significant improvement. This is evident from the Grade VIII E data at the Technical Management Unit of Sukamaju State Junior High School 1, where 22 out of 27 students (81.40%) met the MCC, placing the effectiveness of the media in the 'very effective' category. During the research, class conditions were orderly, students actively participated in learning, completed worksheets punctually, and showed enthusiasm in engaging with the Android-based multimedia. These findings align with studies by Rusli et al. (2019) and Irawan (2021), who demonstrated that Adobe Flash CS6-based educational media effectively enhanced student learning outcomes.

IV. CONCLUSION AND SUGGESTION

Based on the findings of this study, the media validation of the Android-based science multimedia yielded a score of 98.5%, categorized as very valid; material validation achieved 97%, also classified as very valid; video content validation reached 92%, meeting very valid criteria; and the language component scored 86%, also falling into the very valid category. The lesson plan received a validity score of 91.5%, while the student worksheet obtained 92.5%, both indicating very valid classifications. In terms of practicality, teacher responses showed a score of 98%, indicating the multimedia was very practical; student responses reached 84.2%, categorized as practical. Regarding effectiveness, the average individual student score was 87.23%, and the class completeness rate was 81.4%, both falling within the very effective category.

Future research is recommended to develop interactive Android-based learning multimedia across a wider range of subjects and educational levels to examine the consistency of its effectiveness. Additionally, integrating artificial intelligence technologies such as adaptive learning could enhance the personalization of learning experiences. Long-term evaluations are also essential to assess the impact of multimedia on students' retention and comprehension. Subsequent studies should involve multiple schools or regions to improve the generalizability of the findings. Lastly, attention should be given to teacher training in the use of educational technology to ensure effective and sustainable implementation in classroom settings.

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