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The Development of Immune System Smart-Flash Multimedia as Learning Media in MA

Sinta Rahayu[✉], Sigit Saptono[✉]

¹Biology Department, FMIPA, Universitas Negeri Semarang, Indonesia

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Abstract

This study aimed to see the multimedia characteristics of the Smart-Flash Immune System that has been built, the validity of the content and readability, and to see the applicability of Immune System Smart-Flash multimedia. The research was conducted using the Research and Development (R&D) method with the ADDIE (Analysis, Design, Development, Implementation, Evaluation) research model. The data taken in this study were the validity of the Immune System Smart-Flash multimedia in terms of material and media by experts, as well as the application of Immune System Smart-Flash multimedia data in the form of the results of filling out questionnaire responses by students and teachers. The results showed that the Immune System Smart-Flash multimedia had 4 factors, namely it can be used independently by students, has attractive features and display designs, has an animated video that is connected to the original website, and has an evaluation in the form of a puzzle game. The results of validation of material experts 1 and 2 and media experts 1 and 2 were 95%, 90%, 87%, and 87% respectively with very feasible criteria. The responses of students and teachers 1 and 2 obtained a proportion of $\geq 80\%$ with the overall criteria being very good. Based on the research results, it can be seen that Immune System Smart-Flash multimedia was very suitable for use in learning activities.

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[✉] Address Correspondence:
D6 Building 1st Floor Jl Raya Sekaran, Gunungpati, Semarang
E-mail: sintarahayu948@gmail.com

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INTRODUCTION

Along with the advancement of science and technology, the demands for education are increasing. One of these demands is to change the material delivery system that was previously traditional to modern by utilizing advanced technology that can support the learning process and students' understanding of complex material. Computers are one of the most widely used technologies in education. One alternative to using computers to support the learning process is the use of interactive multimedia. Interactive multimedia is a medium of learning that integrates text, images, video, animation, and audio that has been programmed and in use can occur a process of reciprocal relationship or interaction between the user and the program (Mayer, 2009: 2).

Daryanto (2013: 52) stated that the use of multimedia in Biology learning has several advantages, especially in terms of visualization, including: multimedia can make objects that cannot be seen with the naked eye such as cells, bacteria, viruses, and tissues become clearly visible; can visualize objects that have a speed that is too fast or slow, such as the process of urine formation, blood circulation in the body, and the passage of impulses in the body; and can present hazardous learning objects such as crocodiles, snakes, tigers, sharks for biodiversity learning materials. Several studies stated that the use of interactive multimedia can significantly improve student learning outcomes (Osman & Lee, 2013; Leow & Neo, 2014), increase student activity in the learning process (Yumarlin, 2012), and increase student motivation in learning activities (Silva, 2011; Triyanti, 2015).

Multimedia is a program or application that uses multiple types of media, including text, images, graphics, paintings, animation, video, audio, as well as some features that raise the interactivity (Li et al., 2014: 3). Multimedia is a medium of learning that are multi-sensory so that the impact on the level of retention of students become higher. Mayer (2009: 40-43) states that the use of multimedia in the form of graphics and text can increase students' retention (the ability to remember information) by 23% and increase their transferability (ability to apply information creatively) by 89%.

Based on the results of observations and interviews conducted at MA NU Banat Kudus, information was obtained that the Immune System material was one of the materials that were difficult to master by students, it could be seen from the learning outcomes obtained by students. About 60% of the total of 35 students scored below the KKM (75) on the evaluation of the Immune System material. When carrying out learning activities on the Immune System material, the teacher had used learning media in the form of power slides and textbooks, but students still had difficulty understanding the Immune System material. This happened because during the learning process students did not pay much attention to the explanations made by the teacher and tend to be discouraged so that it had an impact on student learning outcomes. According to the informants, there needed to be variety and innovation in the delivery of learning so that students were interested in studying the material and paying attention to the teacher's explanation and could help students understand the material of the Immune System which in turn could optimize students' learning outcomes.

Immune system material was the material given to class XI high school students in the second semester. The material included components involved in the immune system, the mechanism for the formation of specific and nonspecific immune systems, disorders and disorders of the immune system, the mechanism of action of vaccines and monoclonal antibodies, and immunization. Interactive multimedia that presented the material in the form of images, video, audio, and text made teaching and learning activities more interesting. Learning materials could be presented in the form of a series of events that were simplified or enriched so that learning activities were not boring. The use of interesting and innovative learning media was very helpful in motivating students in the learning process so that optimal understanding of the material would be obtained.

Based on the background, it was necessary to develop Immune System Smart-Flash multimedia as a learning medium in MA. The purposes of this research were to describe the characteristics of the development results of Immune System Smart-Flash multimedia, to analyze the content validity and multimedia readability of the Immune System Smart-Flash multimedia material that had been developed,

and to analyze the application of the Immune System Smart-Flash multimedia based on student and teacher responses to limited scale trial.

RESEARCH METHOD

The research method used in this study was Research and Development (R & D) with the ADDIE research model which stands for Analysis, Design, Development, Implementation, and Evaluation. The subjects in this study were 15 students of class XI IPA 2 who were selected using a purposive sampling method. The research steps taken were first, an analysis which includes problem analysis, media analysis, and setting instructional goals. Second, the design included the preparation of material, making flowcharts, making storyboards, and designing the instrument grid needed in the research. Third, development, which includes realizing product development and validation by media and material experts. Fourth, implementation included limited scale trial activities for 15 MA students. The fifth, evaluation included filling out questionnaire responses by students and subject teachers, analyzing the results of filling out questionnaires by teachers and students and making final revisions of learning media.

Types of data taken in this study were qualitative data and quantitative data. Qualitative data were taken from interviews and observations. Quantitative data was taken from the results of media assessments by material experts and media experts as well as the results from filling out questionnaire responses by students and subject teachers.

Data from Immune System Smart-Flash multimedia validation by media experts and material experts would be analyzed using percentage descriptive techniques. The following is the formula used to calculate the score obtained and get the percentage of the validator's assessment (Purwanto, 2010: 102):

$$NP = \frac{R}{SM} \times 100\%$$

Information:

NP = the percentage value sought

R = total score obtained

SM = maximum number of scores

Based on these calculations, the data obtained can be converted with the following criteria:

81% ≤ N < 100%: very feasible

62% ≤ N < 81% : feasible

43% ≤ N < 62% : feasible enough

33% ≤ N < 43% : less feasible

<33% : not feasible

Data on application of Immune System Smart-Flash multimedia were obtained from student and teacher responses about the media. The data that has been obtained are analyzed using the following formula:

$$P = \frac{f}{n} \times 100\%$$

Information:

P: percentage of score

f: the number of students who answered yes

n: the number of students who filled out the questionnaire

Biology teacher response data about Immune System Smart-Flash multimedia was obtained by filling out a questionnaire sheet. The results of the questionnaire were analyzed using the following formula:

$$\text{Responses score (\%)} = \frac{\text{total score obtained}}{\text{maximum total score}} \times 100\%$$

Following are the descriptive criteria for the responses of Biology students and teachers

85% ≤ N < 100%: very feasible

70% ≤ N < 85% : feasible

55% ≤ N < 70% : feasible enough

40% ≤ N < 55% : less feasible

< 55% : not feasible

RESULTS AND DISCUSSION

Characteristics of the Development Result of Immune System Smart-Flash Multimedia

Immune System Smart-Flash multimedia that had been developed had 4 characteristics, namely that it could be used for independent learning by students, had attractive features and display designs, animated videos that were linked to the original website link, and evaluation in the form of a crossword puzzle game. First, it could be used independently. The material expert considered that the presentation of the material was systematic/coherent /had a clear logical flow and could stimulate student participation to learn independently. Dale Parnell in the book *Contextual Teaching Works* (2001: 76) stated that independent learning can bring success to students. During independent learning, students have responsibility for their actions and make their own decisions so that students could find relationships between material with one another with their own experiences.

Second, it had an attractive appearance and design. In the media, 3 features can attract students' attention to learn more deeply about the Immune System material, namely "Ayo cari tahu!", "Ayo berpikir!" and "Sekilas info biologi" (Figure 1). With an attractive display design and features, students can be more interested and excited about learning the Immune System using Immune System Smart-Flash multimedia. Based on the results of the student response questionnaire analysis, 100% of students agreed that learn about immune system with Smart-Flash multimedia-assisted could increase the enthusiasm for learning, made learning activities more enjoyable, and increased student learning motivation. Besides, 100% of students also agreed that the presentation of the material was presented attractively. In their research, Zamani & Nurcahyo (2016) stated that using computer-assisted learning media had a significant effect on student motivation and learning outcomes.

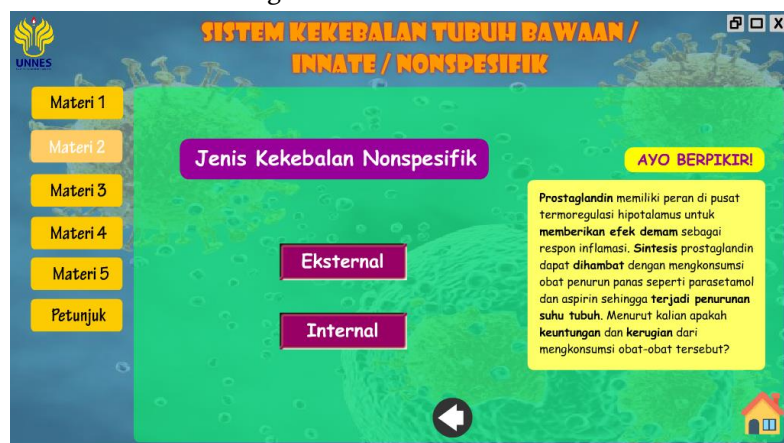


Figure 1. A display of one of the “Ayo Berpikir!” Features on Immune System Smart-Flash multimedia

Third, an animated video that is linked to the original website link (Figure 2). The addition of the link button is based on the advice given by media experts 2, who revealed that there was a need for a link to direct students to the animated video. As for the assessment of media experts, the animated videos used in Immune System Smart-Flash multimedia are interesting, clear, and following the existing learning objectives. A video lesson can serve to visualize something difficult to understand through text or images, such as the occurrence of a mechanism in the body. This is supported by Arsyad (2014: 50) who states that videos can complement students' basic experiences when reading, discussing, and so on.



Figure 2. An example of the display of adding a button that leads the user to the website where the video came from

Fourth, evaluation in the form of a crossword puzzle game (Figure 3). Making evaluations in the form of a crossword puzzle game is based on the results of assessments and suggestions from media and material experts that there is a lack of interactivity in Immune System Smart-Flash multimedia so that researchers add this type of evaluation. Besides, with the evaluation in the form of a puzzle game, the students became more enthusiastic and not bored. Supported by Davis (2009) which states that the use of crossword puzzles in learning activities is more effective because it can accommodate various kinds of student learning styles, reduces student boredom, and provides unique and challenging motivation for students. Stovia & Firmansyah (2020) in their research also stated that the use of crossword puzzles as a learning medium can make teaching and learning activities more interesting and fun.



Figure 3. Display of evaluation of the Immune System material in the form of a crossword puzzle game

Content Validity and Readability of Immune System Smart-Flash Multimedia

Immune System Smart-Flash multimedia validation by material experts included two components, first the feasibility of the content which consisted of material coverage; suitability of material with KD indicators and learning objectives; material insurance. Second, the presentation of the material consisted of presenting learning; communicative and interactive; as well as language. The results of the assessment by Prof. Dr. Retno Sri Iswari, S.U. towards Smart-Flash multimedia got a percentage of 95% with very feasible criteria, while Prof. Dr. Drh. R. Susanti, M.P. provided an assessment with a percentage of 90% having very feasible criteria (Table 1).

Table 1. The results of the Immune System Smart-Flash multimedia assessment by material expert 1 and material expert 2

No.	Scored Aspects	Scores	
		Material Expert 1	Material Expert 2
1.	Content feasibility	26	24
2.	Material Presentation	31	30
Total Score		57	54
Percentage		95%	90%
Criteria		Very Feasible	Very Feasible

Based on the data in Table 1, it was known that the two material experts considered that the Immune System Smart-Flash multimedia in terms of material content was very feasible to be applied in learning activities. In the Immune System Smart-Flash multimedia assessment process, Prof. Dr. Retno Sri Iswari, S.U. as the material expert I and Prof. Dr. Drh. R. Susanti, M.P. as material expert II, provided some suggestions that were used as references by researchers to improve or revise Immune System Smart-Flash multimedia products of Immune System material. First, eliminating Core Competencies from Immune System Smart-Flash multimedia and replacing some learning indicators because they were considered too deep for high school students to learn.

Second, the rearrangement of the material was not systematic and the flow of logic was unclear. In the learning process, the delivery of systematic material would make it easier for students to absorb the material presented. According to Buzan (2005: 63), the brain works synergistically between the left brain and the right brain so that a systematic presentation of the material would make it easier for students to understand and absorb information more quickly. Third, the replacement of animated images with real or original images. Fourth, the replacement of some materials that were considered by material experts to be inappropriate and did not refer to reliable sources. Fifth, the replacement of several terms, words, and sentences that were not quite right in their presentation. In replacing material or terms, researchers refer to several reliable textbook sources, such as the book Immunology by Kuby Janis et al.

Readability validity was carried out by media experts by filling out a validation questionnaire which has 3 assessed aspects, namely software, audiovisual, and others. Based on the validation conducted by media expert 1, namely Lutfia Nur Hadiyanti, S.Pd., M.Pd. the percentage of the assessment results obtained was 87% with very feasible criteria. The same went for media expert 1, Ir. Nur Rahayu Utama, M. Si., As media expert 2 assessed 87% with very feasible criteria (Table 2).

Table 2. The results of the Immune System Smart-Flash multimedia assessment by media expert 1 and media expert 2

No.	Scored Aspects	Scores	
		Media Expert 1	Media Expert 2
1.	Software	19	18
2.	Audiovisual	19	20
3.	Others	14	14
Total Score		52	52
Percentage		87%	87%
Criteria		Very feasible	Very feasible

Based on the data listed in Table 2, it could be seen that the two media experts gave a positive assessment by giving a score that was in a very decent category. This meant that in terms of Immune System Smart-Flash multimedia was very suitable for use in learning activities. In addition to providing an assessment in the form of a score, media experts also provided some comments and suggestions which were used as the basis for researchers to improve Immune System Smart-Flash multimedia. First, improvements

were made to the manual menu by changing the font so that it could be seen and read clearly. Second, we fixed the ActionScript and instance name on some buttons not working properly. Third, an addition was made in the form of instructions for processing evaluation questions which included the number of questions, scores, and processing time. Fourth, improvements in the form of adding links that could direct students to the website page of the video so that students could access more similar videos from the website. According to Sadiman (2010: 74-75) using video when carrying out learning activities could attract students' attention in a short time from other external stimuli. Besides, the use of video could also help students visualize and help confirm the concept of material that has been studied.

Fifth, the improvements made were adding the "let's think" feature to fill in the blanks on page 2 of material 2. The "let's think" feature contained a statement and ended with a question that could stimulate students' curiosity about the answer. Sixth, changed some font colors and backgrounds so that the Immune System Smart-Flash multimedia display was not monotonous but could still be read clearly. This was in line with Nurseto (2011: 32) which stated that the choice of color in a learning medium must be appropriate so that it could beautify the appearance while providing a focus on a point. Sixth, adding features "let's think", "let's find out!", And "at a glance biological info" to fill in the blanks on certain pages. The three features were scattered randomly in Smart-Flash multimedia. The function of these three features was to increase students' knowledge beyond the basic knowledge of the immune system and hone students' thinking and analytical skills.

Application of Immune System Smart-Flash Multimedia

Immune System Smart-Flash multimedia which had been repaired based on suggestions or input from media experts and material experts, was subjected to a limited scale test. The subjects used in the limited-scale trial were 2 biology teachers and 15 students from class XI MIA 2 MA NU BANAT Kudus who were taken by purposive sampling method. The results of the limited-scale trial were in the form of responses given by teachers and students to the use of Immune System Smart-Flash multimedia.

Student response data were obtained from filling out a questionnaire that had 13 questions with two alternative answers, namely "yes" and "no". In addition to answering the available questions, students were also asked to provide feedback in the form of comments and suggestions related to the use of Immune System Smart-Flash multimedia. Overall, the results of the responses given by students have the criteria of "very good" (Table 3).

Table 3. Recapitulation of student response data on limited scale trials

Question Numbers	Answers		Criteria
	Yes	No	
1, 2, 3, 4, 5, 8, 9, 10, 12	100%	-	Very good
11, 7	93.3%	6.7%	Very good
6	86.7%	13.3%	Very good

Based on the data in Table 3, it was known that student responses to Immune System Smart-Flash multimedia received positive responses. Overall, the percentage of student responses was categorized at a very good level with the highest percentage obtained at 100% and the lowest percentage at 86.7%. The percentage obtained in the limited scale trial had met the target that must be achieved, namely the percentage of student responses to the use of learning media $\geq 80\%$.

Suggestions given by students on a limited scale trial were to add a few pictures with the aim that students were enthusiastic about learning the Immune System. In addition, students also gave suggestions for using animation video in Indonesian. The use of Indonesian-language animated videos cannot be realized by researchers because there was no Indonesian-language video that was suitable for the needs of researchers. In overcoming this problem, the researcher placed an animated video at the end of the material after an explanation of the concept and illustration images, so that before watching the animated video

students really understood a mechanism in the Immune System and the animated video had a function to visualize the concept and illustration images had been studied.

The teacher responded to the use of Immune System Smart-Flash multimedia by filling out a response questionnaire that had 15 questions. The results of the analysis of teacher responses to the development of Immune System Smart-Flash multimedia show that the teacher gave a positive response. The result of teacher assessment percentage I was 93.3% with very good criteria and teacher II was 100% with very good criteria (Table 4).

Table 4. Recapitulation of teacher responses to the use of Immune System Smart-Flash multimedia

Respondent	Answers	
	Yes	No
Teacher I	93.3%	16.7%
Teacher II	100%	-

Based on the data in Table 4, the questions contained in the questionnaire almost received a positive overall response except for question number 4, which was about the ease of using Immune System Smart-Flash multimedia in learning activities. The teacher, who gave the answer "no" to the question because according to Teacher I there was a need for face-to-face meetings with students to carry out Immune System Smart-Flash multimedia assisted Immune System learning activities so that it could be known whether or not the learning media was easy to use in learning activities on the Immune System material. The results obtained had met the target that must be achieved, namely the percentage of teacher responses to the use of Immune System Smart-Flash multimedia is $\geq 80\%$.

One of the teachers suggested to the researchers to use a genre of music according to the tastes of high school children because the background music used by the researchers was considered more suitable for elementary or junior high school children. On this basis, the researchers improved Immune System Smart-Flash multimedia by replacing old background music with Mozart's classical genre background music. Several studies stated that classical music can create a comfortable atmosphere and increase one's learning concentration (Andita and Desyandri, 2019; Elvandri and Hermintoyo, 2015).

Overall, the results obtained indicated that Immune System Smart-Flash multimedia was very suitable for use as a learning medium by material experts and media experts. Based on the results of the analysis of the responses given by students and teachers in a limited-scale trial, the application of Immune System Smart-Flash multimedia categorized into the very good category.

CONCLUSION

Based on the results of the research and discussion that have been described, it could be concluded that the Immune System Smart-Flash multimedia had four main characteristics, namely that it could be used by students to learn independently, had attractive features and display designs, had an animated video equipped with a link of the video website, and came with an evaluation in the form of a crossword puzzle game. The content validity and readability of Immune System Smart-Flash multimedia were categorized as very feasible by material experts and media experts. The results of validation by material expert 1 were 95%, material expert 2 was 90%, media expert 1 was 87%, and media expert 2 was 87%. The application of Immune System Smart-Flash multimedia as a learning medium based on the results of student and teacher response data had very good criteria. The highest percentage of student response data was 100% and the lowest percentage obtained was 86.7% and the percentage of teacher 1 and teacher 2 responses were 93.3% and 100%, respectively.

REFERENCES

- Arsyad, A. (2014). *Media Pembelajaran*. Jakarta: PT Raja Grafindo Persada
- Buzan, Tony. (2005). *The Ultimate Book of Mind Maps*. London: HarperCollins
- Dale Parnell. (2001). *Contextual Teaching Works*. Texas: CCI Pub.
- Daryanto. (2013). *Media Pembelajaran*. Yogyakarta: Gava Media
- Davis, TM. (2009). Reviewing for exams: do crossword puzzle help in the success of student learning? *The Journal of Effective Teaching*, 9(2):4-10.
- Desyandri dan Andita, D.D. (2019). Pengaruh Penggunaan Musik Terhadap Konsentrasi Belajar Anak Sekolah Dasar. *Edukatif: Jurnal Ilmu Pendidikan*, 1(3):205-209
- Elvandri, D.R. dan Hermintoyo, H. (2015). Pengaruh Musik Klasik Terhadap Kenyamanan Pemustaka Di Upt Perpustakaan Universitas Pancasakti Kota Tegal Jawa Tengah. *Jurnal Ilmu Perpustakaan*, 3(1):165-174
- Leow, M. F. (2014). Interactive Multimedia Learning: Innovating Classroom Education in A Malaysian University. *TOJET: The Turkish Online Journal of Educational Technology*, 13(2), 99–110.
- Li, Z.-N., Drew, M. S., & Liu, J. (2014). *Fundamental of Multimedia* (D. Gries & F. B. Schneider (eds.); Second). Springer. <https://doi.org/10.1007/978-3-319-05290-8>
- Mayer, R. E. (2009). *Multimedia Learning* (Second). London: Cambridge University Press. <https://doi.org/http://doi.org/10.1017/CBO9780511811678>
- Mulyatiningsih, E. (2011). *Riset Terapan Bidang Pendidikan & Teknik* (A. Nuryanto (ed.); 1st ed.). Yogyakarta: UNY Press.
- Nurseto, T. (2011). Membuat Media Pembelajaran yang Menarik. *Jurnal Ekonomi & Pendidikan*. Vol 8 (1): 19-35
- Osman, K., & Lee, T. T. (2013). Impact of Interactive Multimedia Module with Pedagogical Agents on Students Understanding and Motivation in The Learning of Electrochemistry. *International Journal of Science and Mathematics Education 2013*, 12(2), 395–421. <https://doi.org/10.1007/s10763-013-9407-y>
- Purwanto N. (2010). Prinsip-Prinsip dan Teknik Evaluasi Pengajaran. Bandung: PT Remaja Rosdakarya.
- Sadiman AS, Rahardjo R, Haryono A & Rahardjito. 2010. Media Pendidikan Pengertian, Pengembangan, dan Pemanfaatannya. Jakarta: PT RajaGrafindo
- Silva, H., Pinho, R., Lopes, L., Nogueira, A. J. A., & Silveira, P. (2011). Computers & Education Illustrated plant identification keys: An interactive tool to learn botany. *Computers & Education*, 56(4), 969–973. <https://doi.org/10.1016/j.compedu.2010.11.011>
- Stovia A dan Firmansyah D B. (2020). Peningkatan Penguasaan Kosakata Bahasa Jepang dengan Menggunakan Media Teka-Teki Silang. *CHIE: Jurnal Pendidikan Bahasa Jepang*. 8(2): 77-84.
- Suhartia S, Suparno G, Faizah U. (2013). Profil Media Pembelajaran Multimedia Interaktif Materi Transpor Membran Sel Kelas XI SMA. *BIOEDU*, 2(3): 219-224.
- Triyanti, M., Studi, P., & Biologi, P. (2015). Pengembangan Multimedia Interaktif pada Materi Sistem Saraf untuk Meningkatkan Motivasi dan Hasil Belajar Siswa SMA. *Jurnal Bioedukatika*, 3(2), 9–14.
- Yumarlin, M. (2012). Pengembangan Multimedia Pembelajaran IPS. *JURNAL TEKNIK*, 2(1), 61–68.
- Zamani A Z dan Nurcahyo H. (2016). Pengembangan Media Pembelajaran Berbantu Komputer untuk Meningkatkan Motivasi dan Hasil Belajar Siswa. *Jurnal Pendidikan Matematika dan Sains*, 4(1): 89-100.