Development of E-Modules Based on Articulate Storyline 3 to Improve Critical Thinking Skills and Student Learning Outcomes on the Circulatory System

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Abstract

The development of android-based learning media is an alternative learning media developed by researchers as an effort to improve critical thinking and improve student learning outcomes. Through the development of learning media, students are expected to be able to better understand the subject matter given by the teacher. Thus, it will have an impact on improving students' critical thinking and improving student learning outcomes. This learning media is made using the articulation storyline 3 application which contains text, images and videos.

This type of development research is Research and Development (R&D) which refers to the ADDIE development model. The data collection technique used in this study uses interviews, learning achievement tests, and questionnaires. The data analysis technique used is to use qualitative and quantitative analysis techniques.

The results of the research on the development of e-module learning media based on articulate storyline 3 meet the criteria for very feasible eligibility from the material validator of 82%, the learning media validator of 81%, and from learning practitioners of 89%. Meanwhile, the results of the teacher response questionnaire related to the practicality of the learning media obtained a value of 96% with a very practical criterion and the results of the student response questionnaire obtained a value of 94% with a very practical criterion. As for the N-gain test, the N-gain of the experimental class was 0.44 in the medium category, and the control class value was 0.29 and was in the low category, meaning that the e-module learning media based on articulate storyline 3 was effective in improving students' critical thinking skills. Meanwhile, from the results of the t-test, t count (4.72) ≥ t table (2.039) was obtained. Departing from these data, it can be interpreted that the e-module learning media based on articulate storyline 3 on the human circulatory system is effective in improving the learning outcomes of class XI students of MAN 2 Lamongan

Keywords : *Storiline Articulation, E-module*

1. Introduction

At this time, technology cannot be separated from education because it always helps every aspect of life, including education (Agustian & Salsabila, 2021) . In addition, the rapid development of technology changes the paradigm of education, making teachers or educators the only source of learning and making students work together and encourage each other. As a result, media becomes very important to help students learn (Irvan, 2022) . The world of education must continue to adapt to technological advances to improve education, especially by adjusting the use of information and communication technology to improve

the learning process. learning (Kurniawan & Hasanah, 2023) .

The current curriculum gives teachers the freedom to change their teaching methods. It is expected that teachers will always be innovative and innovative in their learning models and learning media (Mulik, 2023) . According to Khairatunnisa (2022) , the transformation of learning media in education continues to occur due to technological advances. Learning media is now a necessity for students and consists of animations, videos, interactive quizzes, sample questions, and material descriptions. To support the appeal of learning, as well as to support flexible and practical digital era learning, learning media must be developed. Therefore, teachers must improve learning media to meet the needs of students. Because the media used is an important component for teachers in delivering material.

In reality, there are no biology learning materials created by digital-based teachers in the field. Regulation of the Minister of Education and Culture Number 75 of 2020 prohibits the sale of textbooks and school uniforms as regulated in Article 12a. Therefore, teachers must be trained to be creative and create learning media that suit the needs of students, especially electronic media. As a result of the fact that every student has an Android phone, it is expected that they will need alternative learning that does not require textbooks. Therefore, the alternative is to use interactive media such as *articulate storyline 3*.

According to previous studies, such as the results of research by Arman Cahyanto et al., (2022) , interactive e-modules based on *articulate storyline 3* which are used to teach critical thinking skills are highly accepted by expert validators and experts. According to research conducted by Setyaningsih et al., (2020) , the experimental class using interactive learning media based on *articulate storyline* 3 experienced an increase of 70% when compared to the control class using conventional methods. According to research by Umbara et al., (2023) , the results of the questionnaire showed that the e-module product on the Newton's Law material that was compiled received a positive response, with an average percentage score of 85.5%. According to research by Suarsana & Mahayukti (2013) , the results of the validation analysis showed that the compiled e-module met the requirements for content aspects (87.5%) and media (86.9%). According to Agustina et al. (2022), interactive learning media with spoken stories obtained media expert validity of 83.7% and material expert validity of 82.1% .

Based on description the , researchers are interested in do Research on the development of e-modules based on *storyline 3 articulation* to improve students' critical thinking skills and learning outcomes in the human circulatory system for grade XI .

2. Research Method

The method used is the research and development method or Research and Development (R&D). The research and development method is a method used to produce a particular product, and test the effectiveness of the product (Sugiyono, 2018). A product that has been produced requires research that is in the form of needs analysis and to test the effectiveness of the product so that it can function in the world of education.

The product developed in this study is an interactive learning media (e-module) based on articulate storyline 3 on the material of the circulatory system to improve critical thinking

skills and learning outcomes of students in class XI MAN 2 Lamongan. In developing learning media, a development model is needed to ensure the quality of teaching materials in supporting the effectiveness of learning. This study adapts the ADDIE development model which goes through five stages (Analysis, Design, Development, Implementation, Evaluation) (Cahyadi, 2019).

The analysis stage is needed to collect data related to the development of the e-module. At this stage, there are several series that must be carried out, namely analysis of the needs and characteristics of the e-module, technology, curriculum and analysis of student characteristics. The design stage is carried out by creating a design in the form of an overall e-module teaching material framework. The design framework is displayed in the form of a spotlight to facilitate the preparation of the e-module. At this stage, the sequence of presentation strategies, the design used, and the systematics that will be displayed are determined. The systematics of the material from the e-module teaching material are made sequentially from the cover page to the evaluation page. This stage is the stage of realizing the product that has been designed based on the design stage. The previously designed framework will then be realized into a product that is ready to be implemented. This stage will produce an e-module product that is structured according to existing competencies and a questionnaire to measure the validity and practicality of the product.

This development stage produces an e-module product using Storyline 3 articulation in class XI biology learning for the human circulatory system material. The resulting research product is a product that is compiled and must be tested through expert testing. This is done by several experts, namely material experts, media experts, and practitioner experts. Evaluation was conducted on the results of the implementation of the e-module that had been implemented previously, namely to see the effectiveness of the e-module articulate storyline 3 to improve critical thinking skills and learning outcomes of students in class XI MAN 2 Lamongan from. Analysis of the evaluation results was carried out by reviewing whether the e-module Articulate Storyline 3 had been developed to answer the needs and overcome the gaps found at the analysis stage. To analyze the data collected from the questionnaire, there is data that can be quantified (can be numbered) that can be analyzed quantitatively with the aim of getting an overview of the learning media developed. According to Sa'dun Akbar (2013), in analyzing the level of validity descriptively, the following formula can be used:

$$V(ah) = \frac{Tse}{TSh} \times 100\%$$

Information:
V (ah) = expert validation
Tse = total empirical score (expert assessment)
TSh = total expected score

The validation criteria for the learning media developed are as follows (Akbar, 2013):

Table 1. Validation Criteria

Validation Criteria	Validity Level
85.01% - 100.00%	Very valid, can be used without revision
70.01% - 85.01%	Quite valid, can be used but needs minor revisions
50.01% - 70.00%	Less valid, it is recommended not to use because it needs major revision.
01.00% - 50.00%	Invalid, should not be used

The data used to determine the practicality value of the product was obtained based on the completion of the readability test questionnaire by students and the completion of the perception questionnaire by Biology teachers at MAN 2 Lamongan. The results of filling out the practicality questionnaire were analyzed using the formula (Adama Malik and M. Minan Chusni, 2018), as follows.

The percentage results obtained were converted with criteria adapted from Riduwan (2004).

$$\%X = \frac{\sum \text{score obtained}}{\sum \text{maximum score}} \times 100\%$$

The percentage results obtained were converted using criteria adapted from Riduwan (2004).

Table 3 . C o n v e r s i Product Evaluation Score Score

Percentage	Criteria
75.01% - 100%	Very Effective
50.01% - 75.00%	Effective
25.01% - 50.00%	Less Effective
0.00% - 25.00%	Very Less Effective

Data analysis to determine the increase in critical thinking skills and scientific literacy using the N-gain test. The formula for the Ngain test is:

$$\langle g \rangle = \frac{Spost\text{-}Spre}{Smaks\text{-}Spread}$$

Information:

g	= N-gain
Spontaneously	= Post-test score
Spread	= Pre-test score
Smaks	= Maximum score for the question

The results of the n-gain calculation are then categorized into the criteria in Table 3.13 as follows:

Table 4. N-gain Calculation Table

Mark	Criteria

g ≥ 0.7	Tall
0.3 ≤ g < 0.7	Currently
g < 0.3	Low

3. Results and Discussion

This research and development produces an e-module product in the form of a file used to distribute and install Android applications (apk) that can be used as teaching materials on mobile phones, computers, and laptops. The initial display of the media is seen as follows:

Figure 1. Initial display of the media

The main menu display, seen as follows:

Figure 2. Main menu display

Based on the assessment of material experts and media experts. The results of the material expert validity test can be seen below as follows:

Table 5. Material Validation Result Data

No	Aspect	Validation Score	Percentage	Criteria
1	Relevance	24	80%	Quite valid
2	Accuracy	28	80%	Quite valid
3	Suitability of presentation with student-centered learning	18	80%	Quite valid
4	Conformity relating to language with good and correct Indonesian language rules	12	90%	Very valid
5	Aspects of readability and communicativeness	8	80%	Quite valid
	Amount	90	82%	Very valid

The results of the validity percentage of the material expert obtained 82% and showed that the level of material feasibility is very valid . Thus, what the researcher developed that has been made can be used without modification . The material expert validator gave suggestions, namely, adding the material presented, especially material related to the heart and including questions about the structure and function of the heart into the evaluation. The results of the media expert validity test can be seen as follows:

Table 6. Media Validation Result Data

No	Aspect	Validation Score	Percentage	Criteria
1	Media suitability	38	84%	Very valid
2	Visual	2	73%	Quite valid
3	Navigation	24	80%	Quite valid
4	Animated view	5	100%	Very valid
	Amount	69	81%	Very valid

As shown in table 2 , the final percentage results for the interactive learning media articulate storyline *3* show that 81% of the level of eligibility of the learning media to be presented is very valid . Suggestions Which given by expert validator media, namely , the navigator is replaced with a more attractive one and the audio volume can be increased. The results of the user validity test can be seen as follows:

Table 7. User Validation Result Data

No	Aspect	Score	Percentage	Criteria
1	Attraction	27	90%	Very valid
2	Material	26	87%	Very valid
3	Language	9	90%	Very valid
	Amount	62	89%	Very valid

The interactive learning media *for storyline 3 articulation* is suitable for use without revision, because the final percentage results show that the figure of 89% meets the criteria for the level of suitability of the material and media presented .

The practicality of developing the e-module *of articulation storyline 3* can be obtained by using questionnaires and interviews with practitioners and students. The following are the results of the questionnaire for practitioners or teacher users.

Table 8. Expert Practitioner Validator Assessment

No	Assessment Aspects	Score

1	E-module presentation is clear	5
2	The e-module is presented systematically	5
3	E-modules according to student character	5
4	E-modules fulfill learning materials.	5
5	Simple e-module to operate	5
6	E-modules can be carried and moved easily.	5
7	E-modules are reusable.	4
8	Good quality e-module	4
9	E-module storage is easy	5
10	E-modules are safe to store for long periods of time.	5
Amount		48
Average		4.8
Average		96%

The results of the expert practitioner assessment questionnaire conducted by grade XI teachers produced 48 total scores, with an average score of 4.8, and a percentage of 96% for the very practical category. The researcher examined the teachers through response questionnaires and interviews to find out how practical the e-module was. There were no recommendations or improvements from expert practitioners that could be used to directly test the e-module. The following are the results of the questionnaire given to students in small groups.

Table 9. Results of Student Response Questionnaire

No	Student Name	Item Number								Amount	Average
		1	2	3	4	5	6	7	8		
1	A.J.	4	4	3	5	5	4	5	5	38	4.8
2	MY	4	4	4	4	5	5	5	4	38	4.8
3	ANAR	3	4	4	5	5	4	4	5	37	4.6
4	AYS	3	4	4	5	4	5	5	4	37	4.6
5	BWNE	4	3	3	4	5	5	5	4	36	4.5
6	BALM	3	4	4	5	5	4	5	5	38	4.8
7	FBAF	3	4	4	5	4	5	5	4	37	4.6
8	IVNA	3	4	4	5	5	4	5	5	38	4.8
9	KK	3	4	4	5	4	5	5	4	37	4.6
10	MR	4	3	4	5	5	5	5	5	39	4.9
Amount										**375**	47
Average											4.7
Percentage										94%	

According to the table of student response questionnaire results, the e-module that has been created is very practical, with a total score of 375, an average of 4.7, and a percentage of 94%. The results of this implementation will be evaluated to determine the

effectiveness in improving students' critical thinking skills and their learning outcomes. Data analysis to determine how effective the e-module based on *storyline 3 articulation* is in improving students' critical thinking skills using the N-gain test and t-test. The results of this implementation will be evaluated to determine the effectiveness in improving students' critical thinking skills and their learning outcomes. Data analysis to determine how effective the e-module based on *storyline 3 articulation* is in improving students' critical thinking skills using the N-gain test and t-test.

Table 10. N-gain Results of Thinking Ability

Component	Control Class		Experimental Class	
	Pretest	*Posttest*	*Pretest*	*Posttest*
Number of students	32	32	32	32
Average value	13	16	14	18
Gain normality	0.29		0.44	
Category	Low		Currently	

The pretest and posttest values show an increase in the N-gain of critical thinking skills at MAN 2 Lamongan in both control and experimental classes. The pretest value shows an increase in the normality of the gain, with the experimental N-gain value of 0.44 and categorized as medium, and the control value of 0.29 and categorized as low. To determine the effectiveness of the e-module based on *storyline 3 articulation* in improving student learning outcomes, the following is data from the trial activity.

Table 11. Pretest and Posttest Values of Control Class and Experimental Class

No Subject	Control class		Experimental class	
	Pretest	*Posttest*	*Pretest*	*Posttest*
Average	67	75	67	83
Lowest value	55	70	66	75
The highest score	75	80	80	90

The results of the t-test (attachment 7) show that t count (5.717) ≥ t table (2.039). Based on these data, it can be interpreted that the t count value is greater than or equal to t table. Thus, it has a significant value with H1 accepted and H0 rejected. Departing from this, it can be interpreted that the e-module learning media based on *storyline 3 articulation* on the human circulatory system material has a significant effect on improving the learning outcomes of MAN 2 Lamongan students .

4. Conclusion

Based on the results of research and development of articulate storyline 3 media on the topic of the human circulatory system, it can be concluded as follows. The validity of the articulate storyline media obtained validation results from media experts of 82%, material experts of 81% and practitioner experts of 89% with a very valid category and worthy of being tested. In the practicality test conducted on 10 students, the researcher created an e-

module that was included in the very practical category from the perspective of students and the results. The results showed that the e-module was in the very practical category, with an average score of 4.7 and a percentage of 94%. With the results above, the e-module based on the storyline articulation is worthy of being developed and disseminated to students for practicality testing, and can be developed in subsequent studies to see the effectiveness of critical thinking skills, student learning outcomes and student motivation.

The test results showed an increase in the normality of the gain of critical thinking skills at MAN 2 Lamongan, an increase in both the experimental and control classes. The pretest and posttest scores for critical thinking skills of the experiment showed an increase, with an average n-gain value of 0.44 and categorized as medium, while the average n-gain control value was 0.29 and categorized as low. Based on the calculations carried out using the t formula from the table, it was found that the result of the t table was 2,039, in accordance with the interpretation of the t table. Furthermore, it is necessary to compare t count (5.72) with t table (2,039). This result can be interpreted that the value of t count is greater than or equal to t table based on the data. Therefore, it has a significant value with H1 accepted and H0 rejected. Based on this information, it can be concluded that the e-module learning media based on articulate storyline 3 on the topic of the human circulatory system significantly improves the learning outcomes of students at MAN 2 Lamongan.

Thank-you note

Bibliography

1. Agustian, N., & Salsabila, UH (2021). The Role of Educational Technology in Learning. *Islamika* , *3* (1), 123–133. https://doi.org/10.36088/islamika.v3i1.1047

2. Amalia, F., & Kustijono, R. (2017). NATIONAL PHYSICS SEMINAR (SNF) 2017 Effectiveness of using E-Book with Sigil to train critical thinking skills. *NATIONAL PHYSICS SEMINAR (SNF) "Downstreaming Physics Research and Its Learning," November* , 81–85.

3. Arman Cahyanto, Lesmono, AD, & Handayani, RD (2022). Development of Interactive E-Modules Based on Articulate Storyline 3 to Train Critical Thinking Skills on the Topic of Sound Waves. *Journal of Physics Education Literacy (JLPF)* , *3* (2), 154–164. https://doi.org/10.30872/jlpf.v3i2.1551

4. Azizah, VN, & Budijastuti, W. (2021). Flipbook-type illustrative learning media on the immune system material to practice poster making skills. *Journal of Biology Learning Innovation* , *2* (2), 40–51. 10.26740/jipb.v2n2.p40-51

5. Cahyani, A., Listiana, ID, & Larasati, SPD (2020). *View of High School Students' Learning Motivation in Online Learning during the Covid-19 Pandemic.pdf* .

6. Cholifah Mulik. (2023). *Development of Independent Curriculum in Educational Units and Implementation of Independent Curriculum in 21st Century Learning.pdf*.

7. Fatirul, AN, & Walujo, DA (2021). *Research Methods for the Development of Learning Fields* . 14.

8. HPS Muttaqin, Sariyasa, & NK Suarni. (2021). Development of Android-Based Interactive Learning Media in Science Subjects, Topic of Animal Reproduction for Grade VI Elementary School Students. *Indonesian Journal of Learning Technology* , *11* (1), 1–15. https://doi.org/10.23887/jurnal_tp.v11i1.613

9. Hadza, C., Sesrita, A., & Suherman, I. (2020). Development of Learning Media Based on Articulate Storyline. *Indonesian Journal of Applied Research (IJAR)* , *1* (2), 80–85. https://doi.org/10.30997/ijar.v1i2.54

10. Hajar, S., Studi, P., & Kimia, P. (2020). *THE EFFECT OF MULTIMEDIA ON AR R TI C ULA UL A TE STOR YLI NE BASED ON S CO* .

11. Haryanto. (2015). *Educational Technology* (p. 184). UNY Press.

12. Havizul, H. (2020). Development of Interactive Multimedia for Social Studies Learning in Elementary Schools Using the Ddd-E Model. *Social Horizon: Journal of Social Education* , *6* (2), 283–297. https://doi.org/10.31571/sosial .v6i2.1202

13. Indriani, SM, Artika, WI, & Ningtias, WRD (2021). The Use of the Articulate Storyline Application in Independent Learning of Negotiation Texts. *Journal of Indonesian Language and Literature Education* , *11* (1), 25–36. https://ejournal.undiksha.ac.id/index.php/JJPBS

14. Khairatunnisa. (2022). In the Process of Language Learning Based on Information and Communication Technology. *Journal of Education* , *7* (2), 94–99.

15. Kurniawan, A., & Hasanah, U. (2023). *E-Module Based on Articulate Storyline as a Learning Resource for Early Childhood Social Science Learning Development Courses* . *11* (1), 98–105.

16. Ningsih, SY, & Mahyuddin, N. (2021). Design of Thematic E-Module Based on Early Childhood Language Politeness in Kindergarten. *Jurnal Obsesi: Journal of Early Childhood Education* , *6* (1), 137–149. https://doi.org/10.31004/obsesi.v6i1.1217

17. Nissa, ADA, Toyib, M., Sutarni, S., Akip, E., Kadir, S., Ahmad, & Solikin, A. (2021). Development of Learning Media Using Android-Based Articulate Storyline Software for Teaching Algebra in Junior High School. *Journal of Physics: Conference Series* , *1720* (1). https://doi.org/10.1088/1742-6596/1720/1/012011

18. Risma Agustina, Yudha Irhasyuarna, & Sauqina, S. (2022). Development of Articulate Storyline Media on the Topic of Human and Animal Hearing Mechanisms for Junior High School Students. *JUPEIS: Journal of Education and Social Sciences* , *1* (3), 81–89. https://doi.org/10.55784/jupeis.vol1.iss3.119

19. Safira, AD, Sarifah, I., & Sekaringtyas, T. (2021). Development of Web-Based Interactive Learning Media Articulate Storyline in Science Learning in Grade V Elementary Schools. *Prima Magistra: Scientific Journal of Education* , *2* (2), 237–253. https://doi.org/10.37478/jpm.v2i2.1109

20. Setyaningsih, S., Rusijono, R., & Wahyudi, A. (2020). The Effect of Using Interactive Learning Media Based on Articulate Storyline on Student Learning Motivation and Learning Outcomes on the Material of Hindu-Buddhist Kingdoms in Indonesia. *Didactics: Journal of Education and Science* , *20* (2), 144–156. https://doi.org/10.30651/didaktis.v20i2.4772

21. Siswanto, S. (2014). Validity as a Tool for Determining the Reliability of Learning Outcome Tests. *Indonesian Journal of Accounting Education* , *6* (1), 107–117. https://doi.org/10.21831/jpai.v6i1.1795

22. Suarsana, IM, & Mahayukti, GA (2013). Development of E-Modules Oriented to Problem Solving to Improve Students' Critical Thinking Skills. National Journal of Informatics Engineering Education (JANAPATI), 2(3), 193. https: *National Journal of Informatics Engineering Education (JANAPATI)* , *2* (3), 193.

23. Thiagarajan. (1976). Instructional development for training teachers of exceptional children: A sourcebook. *Journal of School Psychology* , *14* (1), 75. https://doi.org/10.1016/0022-4405(76)90066-2

24. Umbara, CMA, . R., & M, R. (2023). Development of E-modules on Newton's Law Material with the Articulate Storyline Application. *Journal of the Physics Alumni Association* , *8* (2), 26. https://doi.org/10.24114/jiaf.v8i2.31970

25. Widiastika, MA, Hendracipta, N., & Syachruroji, A. (2020). Media Development