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Development of a Biology Learning Media-Flipped Classroom Model Using Edpuzzle

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| Septie Nurrokhmah[1,*] | R. Mursid[2] | Dina Ampera[3] |

[1,2,3]Department of Education Technology, Postgraduate, Universitas Negeri Medan, Medan, Sumatera Utara, Indonesia

*septienurrokhmah@gmail.com

ABSTRACT

This research and development aims to produce biology learning media using the flipped classroom model with Edpuzzle that is feasible, practical, and effective in improving student learning outcomes on excretory system material. This type of research is development research using the ADDIE development model with stages: (1) analysis stage, (2) design stage, (3) development stage, (4) implementation stage, and (5) evaluation stage. The research results show: (1) Material expert validation test that the material in the media developed is very worthy with an average score of 88.72%. (2) The Instructional Design Expert validation test is very worthy, with an average score of 96.87%. (3) The Media Expert validation test is very worthy, with an average score of 94.20%. (4) Individual trials are very worthy, with an average score of 87.73%. (5) The small group trial was very feasible, with an average score of 90.90%. And (6) field trials are very worthy of an average score of 90.20%. The practicality test by very practical teachers had an average score of 90.20%, while the practicality test results for students had an average score of 94.90%, which was in the very practical category. Using the flipped classroom model, biology learning media with Edpuzzle in the experimental class got an average learning outcome of 89.68, while students who were taught without this media got an average score of 69.14. Testing the hypothesis using the independent t-test, there is a significant difference between classes taught using the flipped classroom model of biology learning media with Edpuzzle and classes taught without using this media.

KEYWORDS

instructional media; biology; flipped classroom; edpuzzle

INTRODUCTION

Education is a process of individual and personality development that is carried out consciously and responsibly to improve knowledge, skills, attitudes, and values so that they can adapt to their environment. The role of education is very important in creating an intelligent, peaceful, open, and democratic society.

Educational problems also occur in a smaller scope, namely at SMA Negeri 16 Medan, especially in biology learning, which is part of science, as seen from the average scores achieved by students in the previous two academic years, namely 2020/2021 and 2021/2022, which are still not satisfactory, with the percentage of students who have not reached the school's Minimum Completion Criteria (KKM) still quite large. There are still less than 50% of students who reach the KKM in class XI MIPA, so this is a separate note that needs improvement by teachers. Based on these facts, the researcher determined this

learning outcome as a research problem for which a solution must be found by linking the use of information and communication technology in learning.

The above phenomenon can occur due to various factors, including the lack of quality of learning created by teachers as educators, so that the learning process that occurs only consists of conveying information in one direction from the teacher to the students. Meanwhile, problems of a smaller scope also occur in biology subjects. Biology as a science has the characteristics that the object of study is a concrete object that can be captured by the five senses, is developed based on empirical (real) experience, and has systematic steps. To be able to create effective and interesting biology learning, teachers must be able to reflect on the learning that has taken place and improve the quality of learning both in terms of media and model.

Our world of education requires more modern and student-centered learning, where the role of the teacher in the classroom is as a facilitator and motivator by utilizing developments in information technology, including the internet, which is increasingly being used, including among students. The teacher is no longer the only source of information that students have; the teacher is a learning partner (Pertiwi, 2022).

According to Andriyani (2019), the flipped classroom is a learning model where teachers give homework to students so that they actively study learning material provided through media in the form of videos, e-books, or other sources as initial material and preparation for face-to-face activities in class.

Wibowo (2021) states that the flipped classroom is a teacher strategy that limits the amount of direct instruction in the classroom learning process, maximizes students' interaction with each other, and utilizes teaching materials that students will study at home, and then they participate in class with the materials they have provided. studied it.

Several studies regarding the flipped classroom have been carried out and proven to be able to improve student learning outcomes, including research by Pebrianti (2020), which states that this learning model can improve learning outcomes in biology and the concept of the human circulatory system in class XI Science students at SMA Negeri 3 Gowa with very good results.

Other research includes Polat (2021), who states that the flipped classroom model can significantly increase students' academic achievement, academic satisfaction, and general sense of belonging in flipped classrooms compared to other classroom models in Turkey.

This is a flipped classroom learning model. One reason is because they can prepare learning materials before coming to class (Awidi & Paynter, 2019). Farida (2019) stated that the application of this learning model has improved students' learning achievements where they can understand the learning content and obtain high learning scores in exams. Implementation of the flipped classroom learning approach has the potential to train students to be more confident in learning and become independent learners.

Edpuzzle learning, with the help of WhatsApp groups, can be used as an alternative learning innovation in the pandemic era (Sirri, 2020). Based on the results of Murtalib's research (2022), it was concluded that the response of students in mathematics subjects using interactive videos assisted by Edpuzzle in online learning was very positive, at 88.61%.

According to Parlindungan (2020), video is a technology for capturing, recording, processing, storing, transferring, and reconstructing sequences of still images by presenting scenes in electronic motion. Video provides a rich and live resource for multimedia applications. Meanwhile, according to Arsyad (2016), video is a series of moving images accompanied by sound, which forms a unified series to become a plot with messages in it for learning purposes.

In line with the opinion above, Haryanti (2022) states that learning video media is media that presents audio and visuals containing learning messages, whether in the form of concepts, principles, procedures, theories, or applications, to help students understand learning material. Learning media has quite an important function in creating a creative, communicative, and innovative learning process that can support and improve learning outcomes.

The flipped classroom learning model, according to Supratman (2022), was first introduced by J. Wesley Baker in 2000 in his article entitled The Classroom Flip: Using Web Course Management Tools to Be the Guide by the Side. In the same year, Lage, Platt, and Treglia also conducted research using almost the same term, namely the inverted classroom. Several other terms used in various studies that show flipped classroom learning are just-in-time teaching by Novak and inverted learning by Barker.

According to Imania (2020), the flipped classroom is a teacher strategy that minimizes the amount of direct instruction in the learning process. This strategy utilizes teaching materials provided by the teacher, which are given to students to study at home before participating in class learning on the next material. Pulungan (2022) flipped classroom is a form of blended learning where students learn new material at home and what used to be homework is now done in class with teacher guidance and interaction with students instead of teaching. The results of the students' work are discussed and presented.

The formulation of the problem in this research includes: (1) How is the feasibility of biology learning media using the flipped classroom model using Edpuzzle in the biology subject excretory system material? (2) What is the practicality of the biology learning media using the flipped classroom model using Edpuzzle in the biology subject on the excretory system? (3) What is the effectiveness of the biology learning media using the flipped classroom model using Edpuzzle in the biology subject on the excretory system?

RESEARCH METHODS

Research and development aims to produce new products through the development process. Research and development products in the education sector can be models, media, equipment, books, modules, evaluation tools, and learning tools such as curriculum and school policies. The product produced in this research is biology learning media using the flipped classroom model using Edpuzzle for class XI on the excretory system material.

This research uses qualitative and quantitative research methods with the ADDIE model, with the steps of analysis, design, development, implementation, and evaluation.

This research will be carried out at SMA Negeri 16 Medan, which is located at Jalan Captain Rahmad Buddin, Terjun Village, Medan Marelan District, Medan City, North Sumatra Province.

The research subjects on the development of learning media using Edpuzzle with a flipped classroom model oriented towards learning outcomes in class XI excretory system material were Meanwhile, the object of this research is the cognitive abilities of students in biology class.

Quantitative data in this research was obtained through the results of assessment and evaluation scores from expert validation (material experts, media experts, and learning design experts), individual trial evaluations (one-to-one evaluation), small group trial evaluations (small group evaluation). , evaluation of field trials (field trial evaluation), and tests of student learning outcomes (posttest) on the effectiveness of the biology learning products being developed.

This learning outcomes test is useful for finding out whether the learning video media that will be made is effective or not by looking at the learning scores obtained by biology

subject students after being given treatment on the product being tested (post test). The following is the test grid used in this research:

Table 1. Learning Results Test Grid

No	Learning objectives	Realm						Amount
		C1	C2	C3	C4	C5	C6	
1	Students can analyze how each part of the excretory system contributes to the function of removing waste from the body	2	3					5
2	Students can identify and analyze the structure of the organs in the excretory system along with the waste substances produced	1	3	1	5			10
3	Students can evaluate excretory processes, such as blood filtration, reabsorption, and urine formation		1		1	1	3	6
4	Students can analyze the role of each excretory organ (lungs, liver, skin) in removing waste substances from the body and understand the functional relationship between the three	1	3	3	6	1		14
5	Students can analyze various factors that influence excretion in the lungs, liver and skin		1		4	2		7
6	Students can analyze the influence of lifestyle on abnormalities in organ structure and function that cause disturbances in the human excretory system as well as technology related to these disorders		1		4	2	1	8
	Total	**4**	**12**	**4**	**20**	**6**	**4**	**50**

Before the learning outcomes test is used to collect data, the test is first tested to find out whether the test meets the requirements for test validity, test reliability, test difficulty index and test discriminating power.

Table 2. Teacher and Student Needs Analysis Instrument Grid

No	Aspect	Assessment Indicators
1	Needs and interests	Students' needs and interests in using learning videos
2	Benefits	Student enthusiasm and interaction in using learning videos
		Learning videos can create an interesting and fun learning environment
3	Effective and practical	Can improve Biology learning outcomes
4	Student independence in learning	Make students more independent in learning and understanding Biology material

Source: (adapted from Sohaya, 2019)

Table 3. Validation Instrument Grid by Material Experts

No	Aspect	Indicator
1	Material information	Clarity of learning objectives
2	Material quality	Suitability of material to learning objectives
		Coverage and organization of material
3	Design and media quality	Video clarity
		Learning videos can be played without damage

		Design appearance, video, audio quality, images, music, video speed
		Narrator's voice
4	Language and typography	Grammar spelling, font type, font color and font size
5	Evaluation	Clarity of practice questions, level of difficulty and feedback (review) of practice questions

Source: (adapted from Sriadhi, 2018)

Table 4. Validation Instrument Grid by Media Experts

No	Aspect	Indicator
1	Aesthetics	Visual quality, text color composition, background
		Accelerate text, visuals, audio and animation
2	Narration and audio quality	Audio quality, narrator's voice and communicative nature
		Backsound (background sound)
3	Video quality	Learning videos can be played without damage
		Video display speed and video resolution
		Suitability of the object/video/animation with the material
		Consistency of video operational quality
4	Language and typography	Language use
		Selecting the type and size of letters

Source: (adapted from Sriadhi, 2018)

Table 5. Validation Instrument Grid by Learning Design Experts

No.	Aspect	Indicator
1	Learning objectives	Suitability of the formulation of learning objectives
2	Learning activities	Suitability of learning objectives at the learning activity stages (introduction, core and conclusion)
3	Learning methods	Suitability of methods to learning objectives
		Suitability of methods to learning activities (introduction, core and conclusion)
		Suitability of the method to the characteristics of students
		The effectiveness of learning methods in learning activities
4	Learning media	Suitability of media to learning objectives
		Suitability of learning media to learning objectives
		Suitability of media to learning methods
		Suitability of media to student characteristics
5	Times	Accurate time allocation for each stage of activity
		Suitability of time to learning methods
6	Tests	Suitability of tests to learning objectives

Source: (adapted from Bulo, 2020)

Table 6. Table 6. Student Trial Instrument Grid

No	Aspect	Indicator
1	Information	Clarity of description of learning outcomes and learning objectives
2	Material Quality	Suitability of the material to the topic of discussion, learning objectives, concepts or theories and scope of the material
		Arrangement of material sequentially (hierarchical) and orderly (systematic)
3	Design and media quality	Learning videos are easy to understand
		Learning videos can be played without damage

No	Aspect	Indicator
		Quality of design display, video, audio, images, background sound (background sound)
		Video display speed and narrator voice
4	Language and Typography	Spelling and grammar, font selection, font color and font size
5	Pedagogical effects	Needs and interests and benefits of learning videos
6	Evaluation	Practice questions, level of difficulty and feedback (review) of practice questions

Source: (adapted from Sriadhi, 2018)

Table 7. Product Practicality Instrument Grid

No	Aspect	Indicator
1	Suitability of material	The material in the learning media is in accordance with the learning objectives.
2	Presentation of material	Material in systematic learning media
		The material in the learning media is easy to understand
		The material presented is complete and accurate
3	Product presentation	Learning media is very interesting and fun
		Learning media is appropriate to the student's ability level
		Learning media has interesting variations
4	Product use	Learning media is easy to use and access
		Equipped with writing and audio, making it easier for users.
		Learning media can be used anytime and anywhere.

Source: (adapted from Hayati 2023)

Table 8. Media Expert Interpretation, Material, Design, Media User Acceptance

Score	Interpretation	Percentag
5	Very Eligible	85%≤ X ≤100%
4	Eligible	75%≤ X ≤85%
3	Inadequate	65%≤ X ≤75%
2	Not Eligible	55%≤ X ≤65%
1	Very Unfit	0%≤ X ≤55%

Source: (Sriadhi, 2018)

Table 9. Interpretation of Assessment (Validation) by Material, Media and Learning Design Experts

No	Interval Mean Skor	Interpretasi
1	4,17-5,00	Very Eligible
2	3,33-4,16	Eligible
3	2,50-3,32	Inadequate
4	1,00-2,49	Not Eligible

Source: (Sriadhi, 2018)

The normality test is carried out to determine whether the research data is normally distributed or not. This means that the distribution of data in the population is normal or not. Testing the normality of this data uses the Chi Square formula as follows:

$$x^2 = \sum \left(\frac{(F_0 - F_h)^2}{F_h} \right)$$

Information:

x^2 = Chi Square
F_0 = Frequency obtained from the sample
F_h = Expected frequency of the sample

According to Arikunto (2010), the Chi Square value used is with a significance level of 5% and degrees of freedom equal to the number of frequency classes -1 (dk=K-1). If $x^2 count \leq x^2 table$, then it can be concluded that the data is normally distributed.

The homogeneity test is carried out to determine whether the distribution of data in the population is homogeneous. According to Sudjana (2005:249), the homogeneity of variance test can be calculated using the Barlett test, namely:

$$F = \frac{s_1^2}{s_2^2}$$

Hypothesis testing in this Posttest Only Control Group Design research design is by comparing the post test scores of students who use video learning media using Edpuzzle with the flipped classroom model with students who do not use this learning media.

Hypothesis testing in this research was carried out using the t test formula, namely the right-hand test, where the statistical hypothesis being tested can be formulated as follows:

$H_0 : \mu_1 = \mu_2$
$H_1 : \mu_1 \neq \mu_2$

Information:

μ_1 : average learning outcomes of students who use the flipped classroom model learning media using Edpuzzle

μ_2 : average learning outcomes of students who do not use the flipped classroom model learning media using Edpuzzle

H_0 : there is no difference in the learning outcomes of excretory system material for students who use the flipped classroom model learning media using Edpuzzle with students who study conventionally

H_1 : There is a difference in the learning outcomes of excretory system material for students who use the flipped classroom model learning media using Edpuzzle, which is higher than the learning outcomes of students who study conventionally.

To test the hypothesis, a two-party test formula is used

$$t = \frac{\overline{x_1} - \overline{x_2}}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

Where s is the root of the combined variance calculated by the formula:

$$s^2 = \frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1+n_2-2} \qquad \text{where } s = \sqrt{s^2}$$

Information:

$\overline{x_1}$ = average score of the experimental class
$\overline{x_2}$ = average score of the control class
n_1 = average number of experimental classes
n_2 = average number of control classes
s_1^2 = experimental class group variance
s_2^2 = control class group variance
s = combined variance
r = calculation price

The test criteria accept Ha if t count > t table obtained from the t distribution list with dk = (n1 + n2 – 2) and level α = 5%

According to Sugiyono (2019: 415-418), to see the effectiveness value of the product being developed, researchers can compare the effectiveness obtained with ideal effectiveness, which can be formulated as follows:

$$x = \frac{obtained\ effectiveness\ score}{ideal\ effectiveness\ score}\ x\ 100\%$$

A The effectiveness assessment can be seen in table 10 below:

Table 10. Product Effectiveness Assessment Criteria

Value	Achievement Percentage	Criteria
4	76 – 100%	Very Eligible
3	56 – 75%	Eligible
2	40 – 55%	Inadequate
1	0 – 39%	Not Eligible

(Source: Sugiyono, 2019).

Classical Completeness

The effectiveness of the use of learning media is also reviewed by looking at the achievement of the classical Criteria for Completion of Learning Objectives (KKTP). Classical completion is seen from the percentage of students who complete it after using learning media. The basis for determining media effectiveness is if the student's classical completion percentage is > = 85%, then interactive learning media is effectively used (Permadi, 2019). To determine the completeness value, student learning outcomes are classically analyzed using the following formula:

$$\text{Classical completion} = \frac{\text{number of students who completed}}{\text{number of students}} \text{x } 100\%$$

RESULTS AND DISCUSSION

Results

The results of the feasibility test by material experts regarding improving the media structure towards Problem Based Learning (PBL), giving questions according to PBL syntax and the initial syntax in the video should contain triggers that can provoke various critical questions by students. The following is Table 11. assessment by feasibility test material experts:

Table 11. Assessment Result Scores by Two Material Experts

No	Assessment Aspect	Score 1	Score 2	Average	Percentage	Criteria
1	Learning information	4,33	4,50	4,42	88,40%	Very Eligible
2	Material quality	4,33	4,79	4,56	91,20%	Very Eligible
3	Design and media quality	4,36	4,38	4,37	87,40%	Very Eligible
4	Language and typography	4,46	4,40	4,43	88,60%	Very Eligible
5	Evaluation	4,42	4,38	4,40	88,00%	Very Eligible
	Average	4,38	4,49	4,44	88,72%	Very Eligible

The results of the product feasibility test by media experts providing assessments can be seen in Table 12 below:

Table 12. Assessment Results Scores by Two Media Experts

No	Assessment Aspect	Score 1	Score 2	Average	Percentage	Criteria
1	Aesthetics	4,38	4,75	4,57	91,40%	Very Eligible
2	Narrative and audio quality	4,50	4,60	4,55	91,00%	Very Eligible
3	Video quality	4,60	4,80	4,70	94,00%	Very Eligible
4	Language and typography	5,00	5,00	5,00	100 %	Very Eligible
	Average	4,62	4,79	4,71	94,20%	Very Eligible

The results of the product feasibility test by learning design experts can be seen in Table 13 below:

Table 13. Assessment Results Scores by Two Learning Design Experts

No	Assessment Aspect	Score 1	Score 2	Average	Percentage	Criteria
1	Learning objectives	5,00	5,00	5,00	100 %	Very Eligible
2	Learning activities	4,67	5,00	4,84	96,80%	Very Eligible
3	Learning methods	4,67	4,83	4,75	95,00%	Very Eligible
4	Learning media	4,50	4,75	4,63	92,60%	Very Eligible
5	Time	4,67	5,00	4,84	96,80%	Very Eligible
6	Tests (Evaluation)	5,00	5,00	5,00	100 %	Very Eligible
	Average	4,75	4,93	4,84	96,87%	Very Eligible

Results of individual trials at SMA Negeri 16 Medan, carried out on 3 class XI students taken at random. The following table 4 is the result of the individual evaluation trial:

Table 14. Individual Trial Assessment Results Scores

No	Assessment Aspect	Mean	Percentage	Criteria
1	Learning information	4,33	86,67%	Very Eligible
2	Material quality	4,38	87,60%	Very Eligible
3	Design and media quality	4,50	90,00%	Very Eligible
4	Language and typography	4,44	88,80%	Very Eligible
5	Pedagogical effect	4,00	80,00%	Eligible
6	Evaluation	4,00	80,00%	Eligible
	Average	4,275	85,51%	Very Eligible

The results of small group trials at SMA Negeri 16 Medan which were carried out on 9 students aimed to obtain data on the weaknesses and obstacles faced when Biology learning media was tested more widely. The following table 15 is the result of a small group evaluation trial:

Table 15. Small Group Trial Assessment Results Scores

No	Assessment Aspect	Mean	Percentage	Criteria
1	Learning information	4,67	93,40%	Very Eligible
2	Material quality	4,51	90,20%	Very Eligible
3	Design and media quality	4,52	90,40%	Very Eligible
4	Language and typography	4,58	91,60%	Very Eligible
5	Pedagogical effect	4,58	91,60%	Very Eligible
6	Evaluation	4,41	88,20%	Very Eligible
	Average	4,38	90,90%	Very Eligible

The results of field trials carried out at SMA Negeri 16 Medan on class XI students with a total of 34 students. The following table 16 is a summary of the results of field trials that have been carried out:

Table 16. Field Trial Assessment Results Scores

No	Assessment Aspect	Mean	Percentage	Criteria
1	Learning information	4,68	93,60%	Very Eligible
2	Material quality	4,53	90,60%	Very Eligible
3	Design and media quality	4,59	91,80%	Very Eligible
4	Language and typography	4,55	91,00%	Very Eligible
5	Pedagogical effect	4,55	91,00%	Very Eligible
6	Evaluation	4,52	90,40%	Very Eligible
	Average	4,51	91,40%	Very Eligible

The results of the Learning Media Practicality test to test the practicality of the flipped classroom model Biology learning media using Edpuzzle have been given a practicality questionnaire to Biology teachers at SMA Negeri 16 Medan and the results are in table 17 as follows:

Table 17. Practicality Assessment Results Scores by Teachers

No	Assessment Aspect	Mean	Percentage	Criteria
1	Suitability of material	5,00	100%	Very practical
2	Presentation of material	4,67	93,40%	Very practical
3	Product presentation	4,67	93,40%	Very practical
4	Product use	5,00	100 %	Very practical
	Average	4,84	96,70%	Very practical

The results of the Practicality of Learning Media test by Biology Students using the flipped classroom model using Edpuzzle given to students are in Table 18 below:

Table 18. Practicality Assessment Results Scores by Students

No	Assessment Aspect	Mean	Percentage	Criteria
1	Suitability of material	4,77	95,40%	Very Good
2	Presentation of material	4,69	93,80%	Very Good
3	Product presentation	4,73	94,60%	Very Good
4	Product use	4,79	95,80%	Very Good
	Average	4,75	94,90%	Very Good

The results of research in the experimental class showed that the lowest score for students was 72 and the highest score was 100. Meanwhile, the mean score was 89.68. The following is descriptive data for the experimental class in Table 19:

Table 19. Frequency Distribution of Experimental Class Post Test Results

No	Class Intervals	Frequency	Relative Frequency
1	72 - 76	6	17 %
2	77 - 81	5	14 %
3	82 - 86	6	17 %
4	87 - 91	5	14 %
5	92 - 96	10	28 %
6	97 - 101	4	11 %
	Total	36	100%

The results of the research in the control class showed that the lowest score for students was 52 and the highest score was 80. Meanwhile, the mean score was 69.14. The following is descriptive data for the control class in Table 20:

Table 20. Frequency Distribution of Control Group Post Test Results

No	Class Intervals	Frequency	Relative Frequency
1	52 - 56	7	20 %
2	57 - 61	4	11 %

3	62 - 66	7	20 %
4	67 - 71	5	14 %
5	72 - 76	8	23 %
6	77 - 81	4	11 %
	Total	36	100%

The normality test was carried out to evaluate the distribution of the data analyzed. Table 21. Follows:

Table 21. Post-Test Data Normality Test Results

Tests of Normality							
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Class		Statistics	df	Sig.	Statistics	df	Sig.
Excretory System Learning Outcomes	Experimental Class	0,121	36	.200*	0,951	36	0,109
	Control Class	0,123	35	.200*	0,948	35	0,102
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

From the results of the normality test that was carried out on the research data, a significance value of 0.200 was obtained. Based on the criteria used, if the significance value is greater than 0.05, then the data can be said to be normally distributed.

In the homogeneity test, if the significance value is greater than 0.05, then the data distribution is said to be homogeneous. However, if the significance value is less than 0.05, then the data distribution is said to be not homogeneous.

Table 22. Post-Test Data Homogeneity Test Results

		Levene Statistic	df1	df2	Sig.
Excretory System Learning Outcomes	Based on Mean	0,001	1	69	**0,978**
	Based on Median	0,001	1	69	0,978
	Based on Median and with adjusted df	0,001	1	68,125	0,978
	Based on trimmed mean	0,000	1	69	0,983

Based on the homogeneity test results table above, a significance value of 0.978 was obtained. Based on the criteria used, if the significance value is greater than 0.05, then the data is said to be homogeneous. Thus, it can be concluded that this research data is homogeneous.

Submission of Hypothesis

An independent sample t-test was used to see the differences between two unpaired groups. This test is included in parametric statistics, which means that the assumption of normality of the data must be met, or, in other words, the data must be normally distributed. The hypothesis in this research is as follows:

H1: There is a significant difference in learning outcomes between classes that study using the flipped classroom model learning media with Edpuzzle and classes that do not study using the flipped classroom model learning media with Edpuzzle.

Ho: There is no significant difference in learning outcomes between classes that study using the flipped classroom model learning media with Edpuzzle and classes that do not study using the flipped classroom model learning media with Edpuzzle.

There are testing criteria in the independent sample t-test, namely, if the significance value (2-tailed) is smaller than 0.05, then it is said that there is a significant difference. Meanwhile, if the significance value (2-tailed) is greater than 0.05, it can be concluded that there is no significant difference.

Table 22. Independent T-Test Test Results

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Excretory System Learning Outcomes	Equal variances assumed	0,001	0,978	10,480	69	**0,000**	20,603	1,966	16,681	24,525
	Equal variances not assumed			10,479	68,920	**0,000**	20,603	1,966	16,681	24,526

From table 22, it can be seen that the significance value (2-tailed) is 0.000, which means the value is less than 0.05. Based on these results, it can be concluded that there is a significant difference between classes that use the flipped classroom model of learning media with Edpuzzle and those that do not use it.

Determining Classical Completeness

The Learning Objective Completeness Criteria (KKTP) is 78. In this case, we consider classical completeness as the main parameter, which means that a learning media is considered effective if at least 85% of students in the class reach or exceed the KKTP (Permadi, 2019). To determine the completeness value, student learning outcomes are classically analyzed using the following formula:

$$\text{Classical completion} = \frac{\text{number of students who completed}}{\text{number of students}} \text{ x } 100\%$$

1. Classical completion of students who learn using Biology learning media using the flipped classroom model using Edpuzzle (experimental class)

   $$\text{Classical completeness} = \frac{31}{36} \text{ x } 100\% = 86{,}11\%$$

2. Classical completion of students who learn using power point media (control class)

   $$\text{Classical completeness} = \frac{4}{35} \text{ x } 100\% = 11{,}43\%$$

Discussion

The development research carried out is directed at producing a product in the form of biology learning media for class XI students at SMA Negeri 16 Medan so that it can improve the results of the learning process. Aspects were revised and refined based on data analysis and trials, as well as input from material, media, and learning design experts. This aims to explore several aspects that are common in the development process. Aspects of learning media assessed include aesthetics, narrative and audio quality, video quality, language, and typography. Meanwhile, aspects of learning design include systematics, writing display (typography), image display, color display, and audio and narration quality. The learning material aspects assessed are learning information, material quality, design and media quality, language and typography, and evaluation.

Mursid, R. et al. (2022) stated that improving learning outcomes is very helpful in achieving quality science and knowledge in the field, problem solving, developing interests and talents, as well as the application of technology in the 21st century in the ability to think creatively through the application of holistic and effective learning strategies. By developing learning media using various digital applications as done by the author and combining them with various learning models, it is hoped that it can create support for interesting, active, innovative, and meaningful learning for students.

According to Arikunto (2010), practicality is related to the ease of use of evaluation tools, both in preparation, use, interpretation/conclusion of results, and storage. Milala (2022) also states that practicality refers to the ease of use of learning media by teachers and students, which makes the learning process meaningful, interesting, fun, and useful, as well as increasing creativity in the learning process. According to Imania (2020), the ease of using the developed teaching media can help students understand lessons more easily so that learning objectives can be achieved.

The product developed has very good suitability criteria and is effective for use in learning, especially in biology subjects regarding the human excretory system.

This finding is in accordance with existing theory that the use of effective learning media is used to increase the achievement of learning objectives. Nurhayati et al. (2021). Apart from that, interesting multimedia learning media can help increase students' interest and motivation to learn. Interesting media can also make it easier for students to understand and remember the material presented. (Sulistiowati, 2018). Apart from using digital learning media, the author also combines it with the flipped classroom learning model, which has been proven to be effective in improving student learning outcomes. According to Ampera et al. (2021), the flipped classroom is the latest innovative learning model in the digital era, effective in changing students from passive to active, from learners who "don't like" to being responsible for mastering learning content because this model activates and develops students' thinking abilities, both independently and collaboratively. With this model, teachers play more of a role as facilitators, mentors, and motivators.

Nurhayati et al. (2021) stated that the success of the flipped classroom is supported by four important pillars that support each other, as the name FLIP suggests: a flexible environment, a learning culture, intentional content, and a professional educator. By implementing these four pillars, the flipped classroom can increase learning effectiveness and maximize student engagement and achievement.

Classical completeness is an important indicator in assessing the effectiveness of the learning media used in the classroom. In the context of biology learning, media with a flipped classroom model using Edpuzzle has been implemented in the experimental class. The results of the analysis show that the classical completeness of students who study with this learning medium reaches 86.11%. This means that 86.11% of students in the experimental class managed to get a score above 78, which is the Criteria for Completion of Learning Objectives (KKTP).

In contrast, in the control class, which did not use the flipped classroom model with Edpuzzle, classical completion only reached 11.43%. This means that only 11.43% of students in the control class succeeded in exceeding the KKTP. This comparison highlights significant differences in learning effectiveness between the two classes.

Learning media using the flipped classroom model using Edpuzzle has been proven to provide clear benefits in increasing students' learning completeness. By incorporating engaging learning videos that allow students to learn at their own pace at home, Edpuzzle helps strengthen understanding of concepts before discussions and hands-on activities in class. This can be seen from the high percentage of students in the experimental class who achieved the KKTP.

In contrast, the control class that used conventional learning methods (power points) showed much lower completion results. The low percentage of students who achieve the KKTP indicates that the learning medium used is less effective in helping students understand biology material in depth. Thus, the application of the flipped classroom model of learning media using Edpuzzle not only increases student involvement but also

significantly increases learning completion. This provides strong evidence that innovations in learning methods and media can have a substantial positive impact on student learning outcomes.

The benefits of developing biology learning media in the flipped classroom model using Edpuzzle include the following: (1) Providing learning readiness for students because, with the flipped classroom model, they are given material before class learning is carried out. With the right material, they can learn the material so that when learning in class they are ready and can spend more time discussing and collaborating; (2) The material provided is easy to understand because the concepts presented are planned systematically to make it easier for students to learn, but it also provides students with discipline in listening to the material because they cannot skip every part of the media (learning videos); (3) Learning media can provide opportunities for students to learn at their own pace because they can repeat the material presented; and (4) The learning process is more interesting because it presents things that are contextual or related to everyday life.

CONCLUSION

Based on the formulation, objectives, results, and discussion of the development of biology learning media using the flipped classroom model using Edpuzzle, it can be concluded as follows:

1. The biology learning medium with the flipped classroom model using Edpuzzle, which was developed, is very suitable for use in improving student learning outcomes.
2. Biology learning media using the flipped classroom model using Edpuzzle, which was developed to be practically used in improving student learning outcomes.
3. Biology learning media using the flipped classroom model using Edpuzzle, which was developed, is effectively used in improving student learning outcomes. This product is a learning medium that was developed based on students' learning needs.

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