



The development of tic tac toe game media in biology learning of excretory system material for grade XI MAN 3 Bone students

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ABSTRACT

This study aims to determine the characteristics and develop Tic Tac Toe game media in biology learning of excretory system material as a valid, practical, and effective learning media. This type of research is research and development with the ADDIE development model, which includes five stages: Analyze, Design, Develop, Implement, and evaluate. The subjects of the study were students of grade XI Science 1 MAN 3 Bone, with a total of 35 students. The research instruments used are media characteristics sheets, validation sheets, students' response questionnaires and educators' response questionnaires, and learning outcome test questions. The results showed that the characteristics of the developed Tic Tac Toe game media were in the very good category with an average value of 100%. The Tic Tac Toe game media was very valid with an average validity score of 3.46. Based on the responses of students and educators, the Tic Tac Toe game media is in the practical category, with an average score of 85.04% and 89.06%. The level of effectiveness is seen based on the completeness of students, which is 91.4%, so it is categorized as very effective. So, the Tic Tac Toe game media is worthy of use because it meets the criteria of practical, effective, and valid.

Keywords: Characteristics; development; learning media; tic tac toe

1. INTRODUCTION

Education is the provision of teaching by educators to ensure that each person or youth has knowledge and awareness of social relations and societal roles. Everyone is responsible and valuable so that they can influence the thinking power of students to

achieve the goals that have been set and can be carried out properly in line with the achievements desired by students. Education can be realized from planned efforts carried out thoroughly (Ramdayani et al., 2021). Education is a generational transformation of insights, cultures, and values that develop for the next generation (Alamsyah et al., 2022). National education is a planned effort through exercises to realize a learning and learning process so that students can actively improve their potential (Diantoro, 2021). National education plays a role in improving the intelligence of national life and advancing all Indonesians to become obedient humans who believe in the creator of Allah *subhanahu wataala* and have noble morals (Kusumawati & Endang, 2019).

The educational process involves several elements, such as educators, students, and the educational environment. Education is realized through structured and continuous stages (Yusuf, 2015). Education in Islam provides opportunities and platforms for every human being to advance his potential to obtain sufficient knowledge and abilities to carry out his role as a servant on earth (Hidayat et al., 2018).

Education is also explained in QS. Al Baqarah/2:164 that something that Allah has created all have good according to their role. Humans are created with the mind to think and remember what is in this universe so that it becomes evidence of the greatness of Allah Almighty and uses it as a source or medium of learning for people who understand it. As students, we must always study seriously and develop our potential (Shihab, 2022).

The development of self-potential in the learning process is primarily determined by various internal and external school conditions (Nugraha, 2018). Good learning can be created with learning methods that meet students' needs (Hamid, 2020). So, it is vital for educators to be able to determine the appropriate media to be used in the learning process to achieve a series of learning objectives (Nurrita, 2018). Using media will make learning more effective and efficient and create a harmonious relationship between students and educators (Tafonao, 2018).

The results of interviews and surveys conducted by researchers at one of the schools in Bone Regency, namely Madrasah Aliyah Negeri 3 Bone on Thursday, September 15, 2022, the methods and media used are not adequate, the lecture method commonly used is supported by media in the form of general biology textbooks that dominate the text, resulting in students getting bored quickly and easily forgetting the material taught. The survey results showed that 41.7% of students were very interested, and 58.3% expressed interest in learning biology presented using game media.

One of the efforts that can be made to make students active in the learning process is to use media that attracts students' interest and attention (Widyastuti, 2021). One of the media that can be used in the learning process is to use game media. Games can

make children express themselves, which allows them to develop various skills and creativity (Vardani & Indri, 2020). The Tic Tac Toe game is one of the games that can be used to help the learning process and is said to be successful in supporting learning. Tic Tac Toe game media can motivate students to learn and also attract students' curiosity regarding material that is still not understood (Paramita & Durinta, 2018).

The results of previous studies have shown that the Tic Tac Toe game is very effective in improving student learning outcomes (Sulistiani & Rochmawati, 2017). The Tic Tac Toe game was chosen as a learning medium because of its simplicity and easy media application, making it popular with students (Sa'diyah, 2020). Based on the description above, the researcher set a title, "Development of Tic Tac Toe Game Media on Learning Biology of Excretory System Material for grade XI MAN 3 Bone Students".

2. METHODS

This research is a type of research and development or R&D to develop a product or media. This research uses the ADDIE development model, which includes five stages: Analyze, Design, Develop, Implement, and evaluate. This development model can be a good guide in developing a medium because the general framework for learning design offers well-structured phases, and evaluation can be done at each level of the ADDIE development model to adjust to needs. ADDIE's research design is interactive and includes several fundamental learning phases that are efficient, effective, and structured. This research was conducted at MAN 3 Bone—the subject of the study, namely 35 students of grade XI Science 1.

The research instrument to determine the characteristics of the media is the use of media characteristic sheets. The media's practicality level was tested using questionnaires of educator and student responses. The level of media validity is tested using validation sheets and test questions as instruments to test the level of effectiveness of the media. The data collection techniques used are in the form of tests in the form of question items and non-tests in the form of interviews, surveys, questionnaires, validation, and media characteristics. Test media characteristics using media characteristic sheets.

Test the validity of the media using two expert validators. The validity categories can be seen in Table 1.

$$\bar{K}_i = \frac{\sum_{j=1}^n V_{ij}}{n}$$

Information:

K_i : i-th criteria category

V_{ij} : The value of the i-th category performed by the j-th assessor

N : Multiple appraisers

Table 1. validity Level Criteria

Validity Categories	Criterion
$V > 3,4$	Very valid
$2,8 < V \leq 3,4$	Valid
$2,2 < V \leq 2,8$	Quite valid
$1,6 < V \leq 2,2$	Less valid
$V \leq 1,6$	Invalid

(Source: Hartanto, 2020)

Information:

V : Value determination of validity level

The test of the media's practicality level can be measured based on the results of the teacher and student response questionnaires assessment. The practicality category can be seen in table 2.

$$\bar{X} = \frac{\sum_{j=1}^n \bar{A}_i}{n}$$

Keterangan :

\bar{x} : Total average

A_i : Criterion value to i

n : The number of criteria

Table 2. Practicality Level Criteria

Categories Practicality	Criterion
81% - 100%	Very practical
61% - 80%	Practical
41% - 60%	Quite practical
21% - 40%	Less practical
0 - 20%	Very impractical

(Source: Hasan et al., 2021)

The level of media effectiveness is measured based on the results of learning tests obtained by students. The effectiveness rate category can be seen in Table 3.

$$N : \frac{B}{n} \times 100\%$$

Information:

N : Value obtained

B : Number of correct answers

n : Number of question items

Table 3. Effectiveness Level Criteria

Effectiveness Rate	Criterion
0 < TPP < 40	Very low
40 < TPP < 60	Low
60 < TPP < 75	Medium
75 < TPP < 90	High
90 < TPP < 100	Very high

(Source: Hobri, 2021)

The score obtained based on the pretest and posttest values is then calculated using the N gain test. The categories of improvement in learning outcomes can be seen in Table 4.

$$N \text{ gain} : \frac{\text{Posttest value} - \text{Pretest value}}{\text{Maximum value} - \text{Pretest value}}$$

Table 4. Learning Outcome Improvement Criteria

Coefficient interval	Criterion
N gain < 0,3	Low
0,3 ≤ N gain < 0,7	Medium
N gain ≥ 0,7	High

(Source: Hake, 1999)

3. RESULTS AND DISCUSSION

The development of Tic Tac Toe game media excretory system material is compiled, developed, and adjusted based on the ADDIE development model, which includes five stages: Analyze, Design, Develop, Implement, and evaluate (Cahyadi, 2019). The ADDIE

model offers a well-structured phase of creating online and offline learning products. Evaluation can be done at each level of the ADDIE development model to adjust needs. ADDIE's research design is interactive, which includes several fundamental learning phases that are efficient, effective, and structured (Alfah, 2020).

Analysis Phase

Validate Learning Problems

Results of interviews with biology teachers and surveys to students. The problem found is that educators lack biology learning media. Lack of use of learning media can make students less enthusiastic in learning and can also feel bored quickly and bored in learning. This aligns with the research results that the lack of media used in learning can cause students' knowledge and abilities to be less developed and students to feel bored (Sulistiyorini, 2020). Especially in body system materials such as the human excretory system, which, according to students, is difficult to understand because there are too many concepts that is abstract and have many foreign terms that make students not interested in learning the material.

Defining Learning Objectives

Learning objectives are the direction to be achieved from various activities in learning. The learning objectives need to describe four main elements that must be owned to achieve the objectives, including:

Audience, Goals in the Learning Process

The target in the learning process in question is grade XI IPA1 students at MAN 3 Bone, which totals 35 students.

Behavior, Activities carried out in the Learning Process

Activities carried out in the learning process are determining organs, structures, and functions of excretory system organs in humans, analyzing the relationship between structure, organ function, and excretory processes in humans, determining bioprocesses in human excretory organs, and analyzing abnormalities that occur in the human excretory system

Condition, State of Students during the Learning Process

The conditions referred to here are student activities during learning using a Tic Tac Toe game media.

Degree, Student Success Rate.

The level of student success referred to in this case is precisely in reviewing references/media used in the learning process. This can be seen in improving student learning outcomes that show pretest and posttest scores.

Conducting Student Analysis

The average student who was the subject of the study was aged 15-17 years, whereas according to the theory of cognitive development by Piaget, the age of 12 years and over was in the formal operational stage (Ibda, 2018). Individuals at the formal operations stage can think about abstract ideas, arrange ideas, reason about what will happen later, and formulate best guesses about how to solve problems (Mutammam & Mega, 2019). From the analysis of student characteristics, it is known that the learning styles of MAN 3 Bone students are different. Most students like learning while playing; learning with games inspires children to be more involved in solving problems, motivating in learning, and making creative efforts to express themselves (Vardani & Indri, 2020).

Identifying What is Needed

Things needed in this development are a) Material sources that include 1) KD (Basic Competence), Analyzing the relationship between the structure of organ constituent tissues in the human excretory system with its relation to bioprocesses and functional disorders that can be experienced in the human excretory system. 2) The content of the material: The material contained in the learning media is the material of the human excretory system, which includes organs and functions of human excretory organs, the structure of excretory organs, bioprocesses in the excretory organs and abnormalities that occur in the human excretory system. The reference sources used come from books and journals. b) Technology sources: includes laptops with Canva editing applications for designing media printing machines used in printing media. c) Human resources: including educators and students who are the subject of research in testing the practicality and effectiveness of media, experts who help make media pawns, and validators who help revise and assess Tic Tac Toe instruments and game media. d) Facilities and infrastructure: including classrooms used by researchers during the teaching and learning process and package book facilities that become additional learning resources supporting learning activities.

Prepare a Development Implementation Plan

The implementation of development research starts from the analyzing stage to the stage of evaluating Tic Tac Toe products. The plan for implementing development research can be seen in Table 5.

Table 5. Development Research Implementation Plan

Activities	Months
Analyze problems that occur in schools.	September 2022
Development of Tic Tac Toe game media	January-February 2023
Formative Revision	February 2023
Product validation	February 2023
Preliminary trials	March 2023
Implementation in real situations in grade XI Science 1 MAN 3 Bone	March 2023
Evaluation of learning outcomes tests	March 2023

The problem found in schools is the lack of media use in learning. The lack of media use in learning causes students to be less able to optimally achieve the learning process. As explained, the lack of media used in learning can cause learning to be less effective, uninteresting, and slow to understand (Ariyanto et al., 2019).

Design Stage

At this stage, researchers design an initial picture of the content of the game learning media that they want to develop. The learning plan can be formulated through the following stages:

Arrange the Components needed in Making Tic Tac Toe Game Media.

Contents Components

The content component of the Tic Tac Toe game to be developed consists of a game board, X pawn, O pawn, excretion material question cards, hockey cards, and game rules cards.

Design program

The design program in media development is significant because it supports the visualization of the media to be developed. The supporting media for making Tic Tac Toe game media is a laptop equipped with the Canva editing application



Figure 1. Tic Tac Toe Media Design

Developing Product Development Goals

The purpose of developing this Tic Tac Toe game is to be able to answer the problems that exist during initial observation, where students lack media, the learning media used are less varied, and there are too many foreign terms. So, the Tic Tac Toe game can be a learning medium for students.

Developing a Test Strategy

This stage aims to test students' abilities. In the testing strategy, 20 multiple-choice questions were made to find out the extent of student understanding. The questions made are adjusted to KI and KD.

Media is designed on laptops using supporting software such as Canva to create media designs, question cards, award cards, and game rules cards. Then, the X and O pawns are made of wood, and the media box uses plywood glued on each side to strengthen the media. After that, the Tic Tac Toe game media printed using Ritrama Vinyl sticker paper is attached to the media cover. Then, each card is printed using Art paper with a material of 260 grams.

Development Phase

The result of the development stage is a product ready to be tested to determine validity by media and material experts. Here are the stages in development including:

Compiling the Subject Matter

This stage is carried out preparation of the subject matter, namely the excretory system material consisting of organs, structures, functions of excretory system organs in humans, organ linkages, structure, function of excretory system organs in humans, bioprocesses in excretory organs and abnormalities in human excretory organs.

Selecting and Developing Supporting Media

This stage starts with preparing materials and tools, including the description of the material, which is summarized into multiple-choice questions on question cards that will be inserted into the media, as well as sticker paper that is not used to produce Tic Tac Toe game media. The supporting application is Canva to design product displays, game cards, question cards, and hockey cards.

Developing Products and Product Usage Instructions

This is done to make it easier for students to use Tic Tac Toe game media so that students can use learning media easily. At this stage, media production is also carried out based on the design that has been made. After the complementary materials/tools are collected, the plywood cut with a size of 50 × 40 cm is partitioned inside.

The development of Tic Tac Toe media began with making Tic Tac Toe media designs and designing question cards, hockey cards, and hint cards. Next, the last step is to enter the validated multiple-choice questions into the question card.

The following is a media display through the Tic Tac Toe game media design program used.



Figure 2. Tic Tac Toe Game Media Display

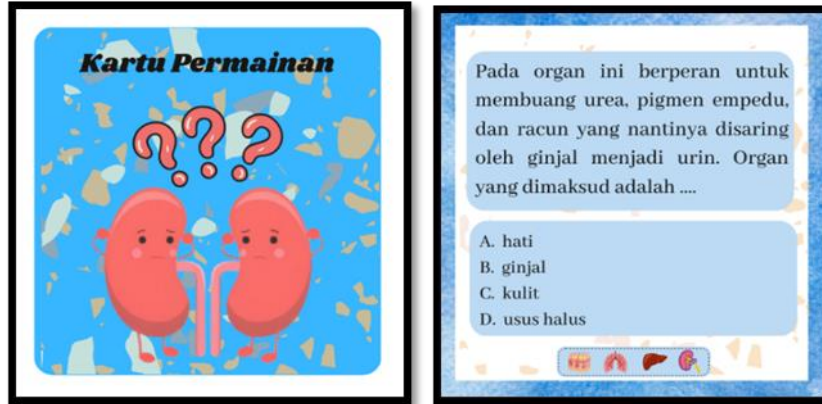


Figure 3. Question Card Display



Figure 4. Hockey Card Display





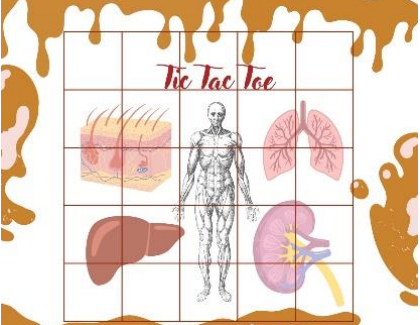

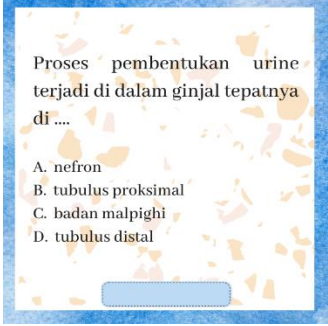
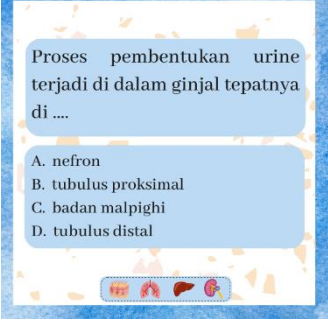
Figure 5. Clue Card Display

Formative Revision

An examination is first carried out on whether this media still has shortcomings. Checking starts from the completeness of the material's content packaged in the form of questions, media display, language used, quality of paper, question cards, hockey cards and instruction cards, X and O pawns, and before the product is implemented. After the

improvement process is carried out, the Tic Tac Toe game media is validated by validators. Through the validation results, revisions are carried out until the resulting product is declared valid and can be implemented in the learning process. The comparison of Prototype 1 and Prototype 2 can be seen in Table 6.

Table 6. Comparison of Prototype 1 and Prototype 2

Prototype 1 (Before Revision)	Prototype 2 (After Revision)
 <p>The color does not correspond to the game medium, and the card's design does not show the excretory organs.</p>	 <p>The color corresponds to the game's medium, and the card's design indicates the excretory organ.</p>
 <p>The game box is not clear; there is no picture of the Tic Tac Toe game and self-identity</p>	 <p>The game box is clear, and the Tic Tac Toe game's characteristics and identity are there.</p>
 <p>Unclear questions due to card background color</p>	 <p>Clear questions with card background color</p>

Doing a Test Run

At this stage researchers conduct preliminary trials of the product on students.

Testing is carried out by piloting the Tic Tac Toe game media, which then students and educators will give their responses in a questionnaire to test the practicality of a media that has been developed. The questionnaire contains several statements with indicators related to the benefits, appearance, ease, and achievement of learning goals from the developed Tic Tac Toe game media.

Implementation Stage

The developed Tic Tac Toe game media is then used in real situations in the classroom. The implementation stage will be on March 30, 2023, specifically for grade XI Science 1 MAN 3 Bone in Tungke Village, Bengo District, Bone Regency, South Sulawesi Province. During the implementation process, students follow the direction of the researchers based on the Lesson Plan that has been designed.

This stage of the game media has been validly implemented in MAN 3 Bone in grade XI Science 1 with as many as 35 students. The purpose of this implementation is to see the implementation of this media in authentic learning and also get responses about how practical students and teachers are about the media developed. In addition, it is also to determine the effectiveness based on student learning outcomes tests so that practical and effective media will be used in the learning process.

Evaluation Phase

This stage is significant in evaluating the shortcomings of any learning media designed to create better learning media. The evaluation carried out is a formative evaluation, where the product is revised again based on comments and suggestions obtained at the implementation stage; these suggestions include hockey cards from 4 to 8 cards, the color of the game pieces changed from brown to blue and yellow, the edges of the X and O pawns smoothed. The Tic Tac Toe game media was added.

This evaluation is an assessment material so that the media can be more optimal and effective. Through this evaluation process, the validation results of the Tic Tac Toe game media of 3.68 were obtained with a very valid category.

Media Characteristics of Tic Tac Toe Game

The characteristics of the Tic Tac Toe game media are obtained based on the results of validators' assessments as media and material experts through media characteristic sheets. The characteristics of the developed Tic Tac Toe game media fully meet the essential characteristics of the Tic Tac Toe game. The Tic Tac Toe game has the characteristic that there are nine square-shaped spaces (3x3) that are partitioned (pieces). This game uses two player symbols, namely X or O. This game begins by filling in one of

the symbol shapes on one of the pieces until three symbols of the same shape are arranged to form diagonal, vertical, or horizontal lines (Dewi, 2018).

Tic Tac Toe Game Media Validity Level

The validity of learning media can be seen from the validator's assessment. The assessment is adjusted in the media validity category table. The average result of validity on the Tic Tac Toe game media is classified as very valid because the average assessment result of the two validators is 3.45. The aspects of appearance, material content, size, language, and appropriateness of using terms obtain very valid results. The validity of this media means that it is suitable for use in research because validators have assessed all aspects contained in the media, and all aspects are classified as valid. The validity results can be seen in Table 9. When the resulting level of validity is valid, then the developed media is valid. However, the level of validity in the learning developed is in the lower category than valid, and it must be revised first to reach the level of validation in the valid category (Simanjuntak, 2019).

Table 9. Validator Assessment Result

Assessment Aspect	Valuation	Categories
Display	3,5	Very Valid
Media Content	3,5	Very Valid
Technical Quality	3,17	Valid
Size	3,5	Very Valid
Language	3,5	Very Valid
Conformity Use of Terms	3,5	Very Valid
Average	3,45	Very Valid

The Practicality Level of Tic Tac Toe Game Media

The level of practicality of learning media is known after the product trial stage, which is measured using research instruments, namely educator response questionnaires and student responses. The results of the analysis showed an educator response of 89.06% and a student response of 85.04%, so the Tic Tac Toe game media is very practical to use in learning learning. The results of the practicality response can be seen in table 10.

Table 10. Overall Response Result

	Types of Assessments	Average	Judging Criteria
1	Educator Response	89,06%	Very Practical
2	Students Response	85,04%	Very Practical

The Effectiveness Level of Tic Tac Toe Game Media

The level of effectiveness of the media is known at the implementation stage by providing a pretest before treatment and a posttest after treatment. Assessment of the improvement of student learning outcomes to determine the level of media effectiveness is measured based on student understanding of the material taught using the media. The percentage of student learning outcomes can be seen in Table 11.

Table 11. Percentage of Student Learning Outcomes

Score	Student Completeness	Sum	Percentage
72-100	Completed students	32 students	91,4%
0-71	Incomplete students	3 students	8,6%
Total		35 students	100%

Based on Table 11. of the 35 total students, 32 obtained scores above KKM with a percentage of 91.4%, and 3 obtained scores below KKM with a percentage of 8.6%. Students are declared complete if they obtain a score greater than the Minimum Completeness Criteria (KKM) ($KKM > \text{Score}$) and the KKM score set is 72.

Furthermore, a Normalized Gain Test (N-Gain) was carried out to determine the change in student learning outcomes from pretest to posttest. The results of the N-Gain Score Analysis can be seen in Table 12.

Table 12. N-Gain Score Analysis Result

Treatment	Average Score of Students
Pretest	26,28
Posttest	78,28
Gain Skor	0,70

The Normalized Gain Test (N-Gain) is carried out to determine changes in student learning outcomes from pretest to posttest. The number of students with high N-gain scores ($g > 0.7$) was 22 students, the medium category ($0.3 < g < 0.7$) was 12 students, and the medium category ($g < 0.3$) was 1 student. Based on the average N-gain score obtained by 35 students, which is 0.77 and is in the category ($0.7 < g \leq 1$), it can be said that the increase in student learning outcomes is high.

The conclusion of this study is the Tic Tac Toe game media on grade XI IPA 1 human excretory system material in MAN 3 Bone, which was developed using the ADDIE model which consists of 5 stages, namely: Analyze, Design, Develop, Implement, and Evaluate. The characteristics of the Tic Tac Toe game media on the grade XI IPA 1 human excretory system material in MAN 3 Bone meet the basic characteristics of the Tic Tac Toe game. The validity level of Tic Tac Toe game media is 3.46 so it is worth using. The level of practicality of the media is the educator's response of 89.06% and the student's response is 85.04% so that the media is said to be very practical to use. The effectiveness level of Tic Tac Toe game media is in the very effective category with the completeness of student learning outcomes of 91.4%.

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