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Development of the Maze Chase Game in Guided Discovery Learning on Student Learning Outcomes

Kholillah Intan Sari Sodiqi, Parmin, Arif Widiyatmoko, Rizki Nor Amelia

[1]Science Education Study Program, Faculty of Mathematics and Natural Sciences, Universitas Negeri Semarang, Semarang, Indonesia 50229

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*Corresponding author:
Kholillah Intan Sari Sodiqi
Universitas Negeri Semarang
E-mail: intanseries279@students.unnes.ac.id

Abstract

Student learning outcomes have an important role in shaping students into careful and skilled individuals. As times progress, technological advances must be balanced with students' cognitive learning outcomes to create an advanced young generation. Improving the learning model towards deficiencies in the learning model such as deficiencies in the guided discovery learning model by considering technological advances aims to maximize student learning outcomes. The aim of the research was to determine the validity of the maze chase game media developed and the differences in the use of maze chase game media development in guided discovery learning between the experimental class and the control class. The development method in this development research is divided into three stages, namely define, design, and develop, while the differentiation test uses a quasi-experimental research design using the pretest-posttest control group design method. The research location is at SMP Negeri 23 Semarang with a sample of class VII A as the experimental class and class VII B as the control class at SMP Negeri 23 Semarang for the 2022/2023 academic year. The data collection technique uses purposive sampling technique and data collection uses test and non-test instruments in the form of questionnaires. The non-test instrument is used to determine the quality of the maze chase game media which shows valid quality, very good readability and very practical practicality. In the test data, there was an increase in N-Gain in the experimental class which was higher than the control class by 0.13 in the medium category. The results of the differentiation test using the Independent Sample T Test showed that there was a significant difference between the experimental class and the control class with a $t_{count} > t_{table}$ value of 1.98.

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INTRODUCTION

Learning is the interaction carried out between educators and students in teaching and teaching activities. In this learning, educators deliver learning material to achieve a goal that has been set in accordance with the curriculum. The 2013 curriculum emphasizes increasing and balancing between attitude, skill and knowledge competencies. This is in accordance with the opinion of Desyandri & Vernanda (2017) where it is said that learning achievement in the 2013 curriculum includes attitudes, knowledge and skills in accordance with national agreements and standards that have been determined. In the journal it is explained that the 2013 curriculum planning uses an integrated thematic approach and its implementation uses a scientific approach which is able to create practical learning. This practical learning includes students' understanding of the activity steps and students' interest in the learning.

Education in the 21st century should be able to shape students to be able to keep up with current developments in science, technology and industrial developments. Based on Minister of Education and Culture Regulation no. 58 of 2014 concerning the 2013 Curriculum explains that education currently being carried out has the aim of creating a productive, creative, innovative and affective young generation through strengthening integrated attitudes, skills and knowledge. The skills referred to are 4C skills. These 4C skills include communication, collaboration, critical thinking and problem solving, and creativity and innovation. According to Pratiwi, et al (2019) the basic idea of education is to build student adaptation so that it is easy for them to survive in protecting themselves against the environment. This is aimed at developing attitudes and mindsets where everyone must compete in various sectors of life in the 21st century. The PISA (Program for International Student Assessment) data results related to science learning in Indonesia are categorized as low. Indonesia is ranked 57th in the field of science, with a score of 383 (OECD, 2022).

Several literatures show the effectiveness of using games in learning comprehension. According to research conducted by Noviyanti (2018) regarding the influence of game-based learning, it has a significant impact on the process of understanding the material by students. Apart from this research, there is also research conducted by Ervan and Ratu (2017) which explains that the digital game-based learning method shows results where this game learning method can increase students' interest and learning outcomes.

Guided discovery learning is a learning model with students as learning subjects so that students have problem solving skills. The use of the guided discovery learning model is also able to provide students with learning opportunities and experiences so that it can help students to construct the concepts being studied (Abdullah, et al., 2022). However, guided discovery learning has shortcomings as explained by Hosnan (2015) where usually this learning often results in misconceptions or misunderstandings between educators and students. These misunderstandings or misconceptions influence student learning outcomes (Triana, 2023).

Misconceptions occur when students are unable to connect new information about an understanding concept with previously existing cognitive structures. According to Setyarini and Admoko (2021) misconceptions in learning can be overcome by reconstructing the knowledge possessed by students. Gultom (2019) in his research shows that misconceptions in the material on the classification of living things also occur, especially in sub-concepts due to a lack of understanding of the concept. Mistakes in understanding the material and interpreting learning concepts have an impact on student learning outcomes (Frans and Wasis, 2022).

The results of interviews conducted with educators at SMP N 23 Semarang, found that there is potential that can be used to maximize science learning. SMP N 23 Semarang allows students to use cellphones or laptops in the school environment. Apart from that, there is school WiFi which can be accessed by students to use. Researchers want to exploit the potential and maximize the learning process in order to maximize students' cognitive learning outcomes. Utilizing the potential of SMP N 23 Semarang can maximize the science learning process where interactive learning media can help the abstract learning process to concrete learning. One of the interactive learning media that utilizes technology is the maze chase game. This maze chase game is an online game where you find the correct answer while avoiding enemies to move on to the next question. With gamification in learning, it will attract students to carry out learning activities and introduce students to the online platform used for learning. Considering the things that have been described above, a game from the development of the maze chase

game in guided discovery learning is expected to be able to maximize learning methods so that it can provide good cognitive learning results.

METHOD

This research develops a maze chase game in guided discovery learning with a 4D development research model (Four D Model) which is modified into 3D according to the needs of researchers. This is in accordance with Pralisaputri, et al., (2016) who explained that 3D research is a modification of the Four D Model research design because the dissemination process is not carried out but is used to analyze effectiveness data using the T, N-Gain and completeness test formulas. Classical This research design uses a quasi-experimental research design. Quasy experiment or quasi-experimental research is a research design used to find the effect of a given treatment (Sugiyono, 2017). This type of research uses the pretest-posttest control group design method. This type of research uses the pretest posttest control group design method. According to Zahra, et al (2021) explain that a quasi experiment is a type of research that uses all objects as a whole to be treated. The research was conducted with pretest posttest control group design by giving a pretest before the experiment and a posttest after the experiment.

This research will be carried out at SMP Negeri 23 Semarang which is located at Jalan Rm. Hadisoebeno Sosro Wardoyo, RT.01/RW.07, Wonolopo, Kec. Mijen, Semarang City, Central Java 50215. The research was carried out in the odd semester on 30 November – 30 December 2022.

The population studied in this research were class VII students at SMP Negeri 23 Semarang and sampling was carried out using the purposive sampling method. Purposive sampling is a technique for sampling data sources with certain considerations. There are 2 sample classes, namely class VII A as the experimental class and class VII B as the control class with a total of 32 children in each class.

The instruments used for this research used test instruments and non-test instruments. Research to measure the effect uses a quasi-experiment research design and a method with pretest posttest control group design.

Table 1. Data Collection Table

Jenis Data	Analisis Data
Validity of instruments and media	Aiken V
Legibility	Legibility Analysis
Practicality	Practicality Analysis
Cognitive Learning Outcomes	Classical completeness analysis and N-Gain Test
Research hypothesis	Independent Sample T-test

The validity of the instrument and learning media is used to measure the validity of developing interactive maze chase game media. This validity uses the Aiken V formula which is assessed by experts and an instrument in the form of a practicality and readability questionnaire which is filled in by students. Media validity analysis is analyzed using the formula:

$$V = \frac{\sum s}{n(c-1)}$$ wherein, S = r – Io

Information:
Io : lowest validity assessment number
c : highest validity assessment number
r : the number given by the appraiser
n : number of experts With the following validity criteria:

Table 2. Validity Criteria

Value Interval	Assessment Category
Very good	81% ≤ score ≤ 100%
Good	61% ≤ score ≤ 80%
Enough	41% ≤ score ≤ 60%
Not enough	21% ≤ score ≤ 40%
Very less	0% ≤ score ≤ 20%

(Huda dan Suryaman, 2022).

In readability analysis using the formula:

$$P = \frac{f}{N} \text{ x } 100\%$$

Information:
P : Percentage of score obtained
f : Total score obtained
N : Maximum number of scores

(Sarip,*et al*., 2022)

Table 3. Readability Criteria

Assessment	Criteria
81 ≤ P ≤ 100%	Very Feasible
61 ≤ P < 80%	Eligible
41 ≤ P ≤ 60%	Fairly Appropriate
21≤ P ≤ 40%	Not Eligible
0 ≤ P ≤ 20%	Very Infeasible

(Riduwan, 2012).

Practicality Analysis uses the following formula:

$$\frac{\text{number of scores obtained}}{\text{number of highest scores}} X100\%$$

(Lestari,*et.al.,* 2018).
With the following practicality criteria:

Table 4. Practicality Criteria

Value Interval	Assessment Category
Very practical	90% ≤ score ≤ 100%
Practical	80% ≤ score ≤ 89%
Quite practical	65% ≤ score ≤ 79%
Less Practical	55% ≤ score ≤ 64%
Not practical	≤54%

(Purwanto,2012).

According to Lestari, et al (2018) stated that media criteria are considered practical if they have a practicality value ≥ 80% and are considered impractical if they have a practicality value ≤ 80%.

Research on the formulation of the influence problem was obtained using a test instrument. The research plan carried out is as follows:

Table 5. Research Design

Class	Pretest	Treatment	Posttest
Experiment	O_1	X	O_3
Control	O_2	Y	O_4

Information:
$O_{1,2}$: pretest in experimental and control classes
$O_{2.4}$: posttest in the experimental and control classes
X : Treatment using the development of the Maze Chase Game in Guided Discovery Learning
Y : Treatment of the Guided Discovery Learning learning model

Pre-test and post-test instruments were used to determine the effect of using the development of interactive maze chase game media in guided discovery learning. This effect was analyzed using classical completeness analysis and the N-Gain test. Classical completeness is analyzed using the formula:

$$P = \frac{\sum ni}{\sum n} \text{ x } 100\%$$

Information:
P: classical completeness
∑ni : number of students who have completed their studies
∑n : total number of students

This analysis is then categorized using the following categorization:

Table 6. Classical Completeness Criteria

Value Interval	Assessment Category
Very good	90% ≤ score ≤ 100%
Good	80% ≤ score < 90%
Enough	70% ≤ score < 80%
Not enough	60% ≤ score < 70%
Very less	< 60%

(Melati,*et.al.,* 2020).

The comparison between the experimental class and the control class was analyzed using the N-Gain Test with the formula:

$$g = \frac{Skor\ Post\ test - skor\ Pre\ test}{Skor\ maksimal - skor\ Pre\ test}$$

Information:
g : the value of the gain factor
$skorposttes$: value after treatment
$skorpretest$: value before treatment
$skormaksimal$: maximum test score

The criteria for the N-Gain value can be seen from the following table.

Table 7. N-Gain Criteria

Value Interval	Assessment Category
High	g > 0,7
Moderate	0,3 ≤ g ≤ 0,7
Low	g < 0,3

(Maulidah *et al.,* 2020).

Analysis of the influence of using maze chase game development media in guided discovery learning on students' cognitive learning outcomes using a parametric test, namely the T-Test after prerequisite tests. The T-Test prerequisite tests are normality and homogeneity tests which are analyzed using the Liliefors test to determine normality and the Bartlet test to determine homogeneity.

The normality test can be formulated as follows:

$$Z_i = \frac{X_{i-\bar{X}}}{s}$$

Information:
xi = data to i
$\bar{x}$ = average data value
s = standard deviation of the data

The significant level used is 5% with a value of α = 0.05. The sample data can be said to be

normally distributed if the value of L count < L table then Ho is accepted, while the data is not normally distributed if L count ≥ L table then Ha is accepted. The homogeneity prerequisite test uses the Bartlet test which can be formulated as follows:

$$\chi 2=(In10)\{(n_i - 1)\log si^2\}$$

Information:
In 10 : 2,303
ni : the amount of data for each group
si2 :Variance of data for each group i

Testing the effect of using maze chase game development media on the guided discovery learning learning model uses a parametric test, namely the T-Test which is formulated as follows:

$$t = \frac{\overline{x - \bar{x}}}{S\sqrt{\frac{1}{n1}+\frac{1}{n1}}}$$

Information:
$\bar{x}$ = Average value of the experimental class
$\bar{x}$ = Average value of the control class
n1 = Number of students in the experimental class
n2 = Number of students in the control class
S = Combined standard deviation
t = Calculated value

So the hypothesis test is formulated as follows:
H_1 : Initial hypothesis, there is no significant effect of using the development of the maze chase game in guided discovery learning on students' cognitive learning outcomes
H_0 : Null hypothesis, there is a significant effect of using the development of the maze chase game in guided discovery learning on students' cognitive learning outcomes (Damanhuri and Solikin, 2023).

The criteria according to Damanhuri and Solikin (2023) with a significance level (α) = 5% for hypothesis acceptance have the following testing criteria:

a. The initial hypothesis is accepted if the calculated value is greater than the table value, and
b. The initial hypothesis is rejected if the calculated value is smaller or equal to the table value.

RESULT AND DISCUSSION

This research aims to determine the validity of the development of the maze chase game media that has been created and its influence on guided discovery learning on students' cognitive learning outcomes. The quality of the maze chase game development media was obtained from non-test instruments to determine the validity of the media as assessed by experts, readability analysis obtained from the assessment questionnaire in the test class, and practicability analysis obtained from the experimental class assessment questionnaire.

The second aim of this research is to test differences in the use of Chase maze game development media in guided discovery learning on students' cognitive learning outcomes obtained from test instruments to determine the comparison of classical completeness, N-Gain, and influence tests using the T-Test.

Validity of Maze Chase Game Development Media in Guided Discovery Learning on Students' Cognitive Learning Outcomes

The validity of the maze chase game development media in guided discovery learning is reviewed from the aspects of validity as assessed by five experts, readability and practicability.

The validity analysis was carried out using the Aiken V formula, namely with the assessment of five raters. Validity is viewed from the media aspect and content aspect. Media aspects Media aspects include indicators of display, control, interaction, and form and content aspects include relevance to learning objectives, material content, questions, and language. In the media aspect, the following analysis results were obtained:

Table 8. The Validity Analysis Media Aspect

Media Aspect	Average	Criteria
Display Indicator	86,67%	Very Good
Control Indicator	93,33%	Very Good
Interaction Indicators	93,33%	Very Good
Shape Indicator	93,33%	Very Good

Meanwhile, in the content aspect, the following analysis results were obtained:

Table 9. The Validity Analysis Content Aspect

Content aspect	Average	Criteria
Learning Objective Relevance Indicators	100%	Very Good
Material Content Indicator	100%	Very Good
Question Indicator	93,33%	Very Good
Language Indicator	93,33%	Very Good

Based on the analysis of the validity test of learning media based on experts using aiken V, it is known that the learning media data using the development of the maze chase game is valid with a calculated V analysis result of 0.94.

Analysis of the readability of the maze chase game development media in guided discovery learning on students' cognitive learning outcomes is assessed based on several aspects. These aspects are aspects of material, language and format. The results of the analysis of the readability of the maze chase game development media are as follows:

Table 10. The Readability Analysis

Aspect	Average	Criteria
Format Aspects	86,56%	Very Good
Language Aspects	90,63%	Very Good
Material Aspects	91,09%	Very Good

This student's readability data consists of 3 criteria according to Sarip, et al. (2022) with 5 indicator points each as an explanation of these criteria. Readability criteria include format aspects, language aspects, and material aspects taken using distributed questionnaires. The readability of a learning media is said to be appropriate if it meets the existing readability criteria. The results of the readability analysis obtained 89.43% which is included in the very good category.

Practicability in this research was measured using a questionnaire method which refers to aspects of ease of use, attractiveness of the presentation, and benefits of the maze chase game media. This aspect is in line with Zidatunnur and Rusilowati (2021) who state that the practicality of using learning media includes aspects of ease of use, presentation aspects, and aspects of the benefits of the media used. Arikunto (2013) explains that practicability has a practical and economic nature.

The practicability analysis has 3 aspects of assessment, namely ease of use, benefits of the media, and enjoyment of the use of developing maze chase game media in guided discovery learning on students' cognitive learning outcomes. The results of the analysis show practicality as follows:

Table 11. The Practicability Analysis

Aspect	Average	Criteria
User Ease	90,94%	Very Good
Media Benefits	90,78%	Very Good
The attractiveness of the dish	90,63%	Very Good

Test of Different Use of Maze Chase Game Development Media in Guided Discovery Learning on Students' Cognitive Learning Outcomes

The effect of using the maze chase game development media was assessed using a test instrument to determine classical completeness between the experimental class and the control class, N-Gain to determine the difference in using the maze chase game media in guided discovery learning on student learning outcomes, and the effect was tested using a test. T-Test.

Classical mastery is analyzed from students' cognitive learning results. The final results of this assessment are in the form of posttest scores obtained at the end of learning on the material on the classification of living creatures in class VII A as the experimental class and class VII B as the control class. The results of the classical completeness analysis are as follows:

Table 12. Classical Completeness of the Experimental Class

Students	The number of Students	Percentage	
		Before	After
Complete (≥70)	29	0%	90,63%
not finished studying (≤70)	3	100%	9,37%

Table 13. Classical Completeness of the Control Class

Students	The number of Students	Percentage	
		Before	After
Complete (≥70)	26	0%	81.25%
not finished studying (≤70)	6	100%	18.75%

The results of the research showed that the classical completeness scores for both the experimental class and the control class had increased. Before learning was carried out, the completeness of the control class and experimental class was 0%. After learning, the results of the classical completeness analysis for both the experimental class and the control class reached 90.63% for the experimental class and 81.25% for the control class. So that according to the completeness criteria, the experimental class is included in the very good category and the control class has good classical completeness. There is a difference of 9.38% between the experimental class and the control class in classical completion after different treatments were carried out in the learning process

The increase in students' cognitive learning outcomes was measured using pretest and posttest questions totaling 25 questions in the form of multiple choice questions. The data obtained were then analyzed using the N-Gain test.

Table 14. Results of N-Gain Test Analysis of Cognitive Learning Results

Criteria	Experimental Class		Control Class	
	Pre	*Postt*	*Pre*	*Post*
Students	32	32	32	32
The highest score	52	96	48	92
Lowest Value	24	56	24	60
Average	38,75	80,25	37,63	73
N-Gain	0.68		0.57	

The results of the analysis carried out using N-Gain in the experimental and control classes showed an increase in cognitive learning outcomes in the medium category. In research on students' cognitive learning outcomes, Bloom's taxonomy is considered, namely C1 (Knowledge), C2 (Understanding), C3 (Application), C4 (Assessment), C5 (Evaluation), and C6 (Creation). In the experimental and control classes, the increase in students' cognitive learning outcomes for each indicator of cognitive learning outcomes which includes Bloom's taxonomy was analyzed. The results of the indicator analysis can be seen in Figure 4.1 below:

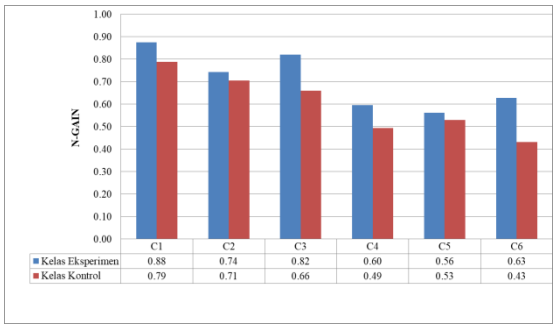

Figure 1. Results of N-Gain Test Analysis of Cognitive Learning Results for Each Indicator

The T-Test was used to determine the significant effect of using maze chase game development media in guided discovery learning on students' cognitive learning outcomes. The T-Test uses two independent samples to determine significant differences between the two.

Independent Sample T-test analysis can be seen from the following table:

Table 15. The *T-Test* Analysis

Data	Average value		t_{count}	t_{table}	Description
	Experiment	Control			
Pre	38.75	37.625	0,65	2,003	There is no significant difference
Post	80.25	73	3.98	2.003	There is a significant difference

Hypothesis testing or influence testing is carried out to determine the significant influence of a treatment on research variables. Hypothesis results using an independent sample t test using cognitive learning outcome scores in the experimental and control classes showed that the ttable value was smaller than the tcount value. The results of hypothesis

testing using the T test showed that there was an influence of using maze chase game media on guided discovery learning with a t-count of 3.98.

So it can be concluded that H0 is rejected and Ha is accepted with the conclusion that the use of maze chase game development media in guided discovery learning has a significant influence on students' cognitive learning outcomes. This is in accordance with Widyatmojo and Muhatadi (2017) who stated that the development of interactive learning media in the form of games is able to stimulate students' cognitive aspects.

CONCLUSION

The results of the research "Development of the Maze Chase Game in Guided Discovery Learning on Student Learning Outcomes" concluded that the development of the interactive media maze chase game used in guided discovery learning on cognitive learning outcomes has valid, reliable quality, very good readability, and very practical practical. The use of developing maze chase game media in guided discovery learning has an effect on classical completion tests, average gain tests, and influence tests on students' cognitive learning outcomes. In the classical completeness test, it was proven that the experimental class's classical completeness was 90.63% greater than the control class's 81.25%. In the test the average increase (gain) was proven by the average increase (gain) of the experimental class of 0.68 in the medium category, which was greater than the control class of 0.57 in the medium category. In the influence test, the $t_{count} > t_{table}$ value was 3.98> 2.0003.

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