Electronic Journal of Education, Social Economics and Technology
Vol. 6, No. 1, (2025), pp. 1281~1287
ISSN 2723-6250 (online)
DOI: https://doi.org/10.33122/ejeset.v6i1.375

Research Article

Si Tole Game to Improve Students' Critical Thinking Skills on Reaction Rate Material

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ABSTRACT

The learning media used by most teachers in schools are power point and whiteboard media. However, these media do not significantly influence students' learning motivation, leading to a decrease in their critical thinking skills. In contrast, the independent curriculum requires students to fulfill the learning objectives for critical thinking. With the aim of improving students' critical thinking skills on reaction rate material, this study tries to create a game media Si Tole. This study uses a research and development model according to Borg and Gall. The data obtained were then analyzed for validity, practicality, and effectiveness. The validity analysis findings demonstrated that the Si Tole game medium met excellent standards for validity, 93% of the findings of the practicality analysis met the practical requirements and the effectiveness analysis's findings yielded a gain value of 0.8 with a high category. So it can be concluded that the Si Tole game media is valid, practical, and effective in improving students' critical thinking skills in the reaction rate material.

Keywords: Si Tole; Critical Thinking Skills; Reaction Rate

1. INTRODUCTION

The learning and teaching process involves a reciprocal relationship between educators and students in an educational atmosphere, with the aim of achieving learning goals (Cikka & Kahar, 2021). The learning objectives that have been achieved indicate that the teacher has succeeded in providing learning. Learning objectives have been included in the curriculum. The curriculum is a program provided for students, the program contains a series of student activities to produce development and changes in student skills. (Batubara, 2021).

A key role in the educational process is played by the curriculum (Reksoatmodjo, 2010). A good curriculum is a curriculum that is always reviewed from time to time to adapt to developments in the era. In the 21st century, the curriculum implemented is the independent curriculum. As per the Decree of the Minister of Education and Culture (Kepmendikbudristek, 2022), teachers have the freedom to choose the learning models and tools that have been provided and are required to develop various teaching tools that are in accordance with learning needs. This statement is implemented for all materials, including the Reaction Rate material.

The reaction rate material is material that explains the causal relationship and phenomena that occur. Sub-materials on the reaction rate are, (1) the concept of reaction rate, (2) factors that affect the reaction rate, (3) collision theory, (4) reaction rate equation, and (5) reaction order (Sucipto, 2019). The reaction rate is the main material of chemistry in phase F, in phase F The following are the learning objectives that students must meet that students are expected to have increasingly critical and open minds through scientific work and to strengthen the profile of Pancasila students (Kepmendikbudristek, 2022). However, in reality students have low critical thinking skills.

Critical thinking ability is a high-level cognitive ability that includes analysis and synthesis, making it an important component in learning (Marasigan & Espinosa, 2014). Critical thinking, according to Facione (2011), has 6 indicators, namely, (1) interpretation, (2) analysis, (3) inference, (4) explanation, (5) evaluation, and (6) self-regulation. Students' capacity for critical thought gets an average of below 50%, which is in the low category. Based on the results of the pre-study, students get the results of the interpretation indicator of 28.4%, the analysis indicator of 43.9%, the inference indicator of 39%, and the explanation indicator of 37.06%, while the evaluation indicator is carried out by the teacher during the summative test, and the self-regulation indicator can only be done with non-test methods.

The lack of critical thinking abilities possessed by students are brought on by a number of factors, including the usage of less creative educational materials, so that students become less motivated to learn.. This assertion is consistent with

studies that have been done by Karina et al. (2019), which states that the learning media used by the majority of teachers are powerpoint and whiteboard media. So learning media are needed that can increase students' learning motivation so that they can increase critical thinking abilities of students.

One educational resource that might boost pupils' willingness to learn is in the form of games. The development of the younger generation's character in education as a whole is one of them through game media (Sofianto, 2016). With the implementation of games in chemistry learning as a means of education, it should be fun so that children do not feel pressured or forced (Nurhidayati, 2012). With the existence of games, learning in the classroom will be active because students enjoy learning more. There are several previous studies that are relevant to this study. In a study by Lindawati & Wardani (2016), they wrote that there was a substantial impact on pupils' critical thinking abilities and learning outcomes on the material of alkene compounds.

The improvement in pupils' critical thinking abilities and learning results is influenced by the chemistry board game media that was developed. Research by Fathonah et al. (2021) also shows that the Chemfun board game media, which is oriented towards scientific literacy in the material of chemical bonds, is valid, practical, and effective as a learning medium. In addition, Lailia (2019) developed a question card game that is effective in enhancing social studies students' critical thinking abilities, and the results show that the game is valid and practical. Research (Tsai et al., 2020) supports this finding, stating that the use of game media can enhance pupils' comprehension and critical thinking abilities.

These studies emphasize the validity, practicality, and effectiveness of game media developed to improve Critical thinking abilities of student. It can be seen that game media can provide a new atmosphere in the world of education, to enhance student capacity for critical thought. Therefore, the advantages of this game media can be used for students to improve their capacity for critical thought, where this ability is an ability that must be possessed by students. However, in reality, Students' ability to think critically is lacking. With the urgency of this research, the researcher is interested in conducting research that aims to develop the Si Tole game media to improve the critical thinking skills of class XI students of the International Madrasah Amanatul Ummah on the material of reaction rates.

2. RESEARCH METHOD

This study uses a research and development model initiated by Borg and Gall (2007). There are two approaches in this study, namely, a qualitative approach and a quantitative approach. The research sources used consist of two parts, namely, primary data sources and secondary data sources. The primary data source is 16 students of class XI of the international standard madrasah Amanatul Ummah, while the secondary data sources are related articles and literature. There are three research analysis techniques, namely, validity analysis, practicality analysis, and effectiveness analysis. Validity analysis consists of analysis of review data and analysis and validation. Analysis of review data uses a qualitative approach, and the instrument used is a review sheet. After the data is obtained, the data is analyzed by reviewing the results of comments and constructive suggestions for improvement. After the improvements are made, the data is validated by the validator. Validity data analysis uses a quantitative approach, and the instrument used is a validation sheet. The data obtained will then be analyzed using mode and can be said to be valid if the mode is ≥3. Practicality analysis consists of analysis of student response questionnaires and analysis of student activity observations. The analysis of the student response questionnaire used a quantitative approach, which was analyzed by distributing a response questionnaire sheet containing yes or no questions and calculated using the formula of the total score obtained divided by the total number of students multiplied by the highest score and multiplied by one hundred, and can be said to be practical if the percentage of practicality is ≥61%. The questionnaire response data is supported by student activity observation data. Observation of student activities used a quantitative approach and was analyzed by observing prominent activities every three minutes for two lesson hours using a student activity observation sheet, then the data was calculated using the formula of the number of activities carried out divided by the total number of activities; it can be said to be practical if the number of relevant activities is more than 61%. And the effectiveness analysis consists of two analysis techniques, namely, critical thinking ability test analysis and knowledge test analysis, using pretest and posttest sheets. The analysis of the critical thinking ability test was calculated using the formula of the total score obtained multiplied by the maximum score and multiplied by 100. The data obtained was analyzed using the T and N-Gain tests using SPSS, with the effectiveness category considered adequate if the significance value <0.05 and the Gain value is in the medium to high category

3. RESULTS AND DISCUSSION

This study was carried out at the Amanatul Ummah International Standard Madrasah in the 2024/2025 academic year. This research was conducted with four meetings without a comparison class. The first meeting was a pretest of critical thinking skills and knowledge to determine the initial abilities of students. At the second and third meetings, the implementation of the Si Tole game media was carried out in learning. and at the fourth meetinga posttest was administered to ascertain the student proficiency. after the implementation of the Si Tole game media in learning

3.1 Planning

After conducting a preliminary study in the form of potential problems and data collection, information was obtained to be used as an initial step in identifying student needs. The researchers' next task is to schedule the creation of this gaming media. The steps taken by researchers in product development planning include determining research objectives, selecting media and formats, and designing the initial game media.

Figure 1. Si Tole's Board Game

(Source: Data Processing Results, 2024)

Figure 2. Question Card

(Source: Data Processing Results, 2024)

Figure 3. Challenge Card

(Source: Data Processing Results, 2024)

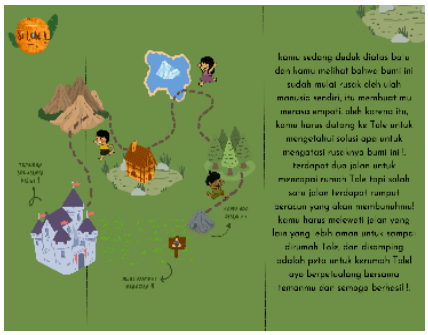

Figure 4. Booklet
(Source: Data Processing Results, 2024).

3.2 Initial Product Design Development

After planning in the form of formulating objectives, selecting media and formats, and initial sketches of the media, an initial sketch of the Si Tole game media was obtained that would be developed. The next step is for the researcher to develop the initial product design of this game media. The steps taken by the researcher in developing the initial product design include compiling research instruments and conducting media reviews and validation by validators.

a. Validity Analysis

1) Media review

The analysis of media review data uses a qualitative approach, namely by analyzing the results of constructive suggestions and comments on the Si Tole game media. The results of the review obtained are then used as a reference for revisions that will produce draft 2 which will then be validated.

2) Media validity

The validity analysis of the Si Tole game media uses mode, the aspects assessed in the validity of this game media, include aspects of construct validity and this validity which is shown in **Table 1**.

Table 1. Results of Construct and Content Validity Tests

Aspects	Modus	Category
Construct Validity	4	Good
Content Validity	4	Good

(Source: Data Processing Results, 2024)

Based on the validity criteria of the developed game media, the Si Tole game media achieved a good category with a modal value of 4, so the Si Tole game media is valid

3.3 Initial Field Testing

After developing the initial product design in the form of compiling research instruments and conducting media validation, valid results were obtained from the Si Tole game media that will be developed. The next step is for researchers to conduct initial field tests by implementing this game media directly to students. In the initial field test, several limitations were found in the Si Tole game media, namely that there were no consequences when players answered incorrectly, so players only got a score reduction without any additional questions to train their thinking skills. Furthermore, there was no automatic assessment in assessing each answer in the game, so that in its implementation it took longer. So based on the limitations that exist, it is hoped that in further research it can be developed even better.

a. Practicality Analysis

1) Student Response Questionnaire

The An examination of the student response survey was conducted by distributing the response questionnaire to students after learning using the Si Tole game media. The data obtained were then analyzed using the following practicality criteria.

Table 2. Results of the Construct and Content Response Questionnaire

Aspect	Average (%)	Category
Content	96,59	Very Good
Appearance	93,18	Very Good
overall average (%)	94,60	Very Good

(Source: Data Processing Results, 2024)

Based on the **Table 2**, it can be concluded that during learning using the Si Tole game media, students felt helped in practicing their critical thinking skills in order for pupils to develop their critical thinking abilities and students also felt that learning using the Si Tole game media was fun with an average percentage of 94.60% with very good criteria, so that the Si Tole game media can be said to be practical.

2) Observation of Student Activities

Analysis of student activity observations was carried out as supporting data for practicality analysis, which was carried out by observing prominent student activities every three minutes during two lesson hours. The data obtained will produce relevant activities and irrelevant activities as follows.

Table 3. Results of Observation Analysis of Student Activities at the First Meeting

Aspect	Average (%)
Relevant Activities	97,65
Irrelevant Activities	2,35

(Source: Data Processing Results, 2024)

Based on **Table 3**, it can be seen that at the first meeting, Students eagerly participated in the learning process. This statement is indicated by the percentage of relevant activities of 97.65 while irrelevant activities only got a percentage of 2.35. Next are the findings of the student analysis activity observations at the second meeting as follows.

Table 4. Results of Observation Analysis of Student Activities at the Second Meeting

Aspect	Average (%)
Relevant Activities	98,86
Irrelevant Activities	1,14

(Source: Data Processing Results, 2024)

Based on **Table 4**, it can be concluded that the Si Tole game media can increase learning motivation, this is indicated by an increase in the percentage of relevant activities, which is +1.21% and a decrease in the percentage of irrelevant activities by -1.21%. Thus, it can be concluded that the response questionnaire that has been filled out by students is in accordance with the activities carried out by students during learning using the Si Tole game media, this is indicated by an increase in the percentage of relevant activities.

b. Effectiveness Analysis

1) Critical Thinking Ability Test

This study was conducted on 16 students of the International Madrasah Amanatul Ummah. Before testing the improvement of critical thinking skills results, it is necessary to conduct a prerequisite analysis test which includes a normality test presented in **Table 5**.

Table 5. Normality Test Results

Test	Significance	Condition	Information
Pretest	0,694	>0,05	Normal
Posttest	0,115	>0,05	Normal

(Source: Data Processing Results, 2024)

Based on **Table 5**, it can be seen that the significance value is >0.05 so it can be concluded that the test data is normally distributed. Furthermore, the data was tested using the t-test to determine the effect of the Si Tole game media on students' critical thinking skills which are presented in the following table.

Table 6. T-Test Results

Variabel	Significance	Condition	Information
Pretest-Posttest	0,000	>0,05	Normal

(Source: Data Processing Results, 2024)

Based on **Table 6**, it is known that the significance (2-tailed) is 0.000 which is less than the significance level (α), namely 0.05. From these results, it is known that H0 is rejected and H1 is accepted, meaning that there is a significant influence between the independent variables on the dependent variables, where the independent variable is the Si Tole game media and the dependent variable is the critical thinking skills of students. So it can be concluded that through learning using the Si Tole game media, students' critical thinking skills can be improved. Furthermore, the data was tested using the n-gain test to determine the increase in students' critical thinking skills, which is presented in the following **Table 7**.

Table 7. N-Gain Test Results

Test	Average	Condition	Information
Gain	0,8187	>0,7	Greater

(Source: Data Processing Results, 2024)

Based on **Table 7**, it can be seen that the N-Gain score test above obtained a Mean or average value of 0.8187 which is greater than 0.7 with a high category. So it can be concluded that the Si Tole game is effective in improving students' critical thinking skills in the reaction rate material.

2) Knowledge Test

In addition to the critical thinking ability test, the effectiveness analysis is also supported by a knowledge test at the end of learning using the Si Tole game media. The knowledge test analysis is carried out by calculating the individual completeness and the number of classical completeness of students, then the data is tested N-Gain to determine the effect of the Si Tole game media on student knowledge.

Table 8. Individual Completion

Criteria	Pretest	Posttest
Finished	4 people	16 people
Not Finished	12 people	-

(Source: Data Processing Results, 2024)

Based on **Table 8**, it can be seen that there is a significant influence between the Si Tole game media on student learning outcomes, which can be shown by the number of students who completed the posttest. Furthermore, the data is processed using classical completeness to determine the percentage of students who complete, a class can be said to be complete if it gets a percentage of ≥85%.

Table 9. Classical Completeness

Test	Finished Student	Not Finished Student	Student	Classical Completion (%)
Pretest	4 people	12 people	16 people	25
Posttest	16 people	-	16 people	100

(Source: Data Processing Results, 2024)

Based on **Table 9**, it can be concluded that the Si Tole game media has a significant effect on students' knowledge. This can be shown by the classical completeness in the posttest of 100% and has increased from before and after learning using Si Tole, which is 75%. And then the data was tested using the n-gain test to determine the effect of the Si Tole game media using SPSS.

Table 10. N-Gain Test Results

Test	Average	Condition	Information
Gain	0,8409	>0,7	Greater

(Source: Data Processing Results, 2024)

Based on **Table 10**, it can be seen that the n-gain test obtained an average value of 0.84 which is greater than 0.7 with a high category. So it can be concluded that the Si Tole game media is effective in improving student learning outcomes in the reaction rate material. Based on the research results, the Si Tole game media is valid, practical, and effective to train students' critical thinking skills. This is in line with the purpose of conducting validity, practicality, and effectiveness tests, namely so that the Si Tole game media produced becomes a good and quality practice media for students (Candra & Rahayu, 2021). The advantages of the Si Tole learning media that were developed are that the Si Tole learning media is different from existing media in terms of material, Si Tole board design, game rules and cards. Not only that, in terms of use and storage, this Si Tole game media is very easy, this can be seen based on the results of the student response questionnaire which obtained an average score of 93% with a very practical category

3.4 Initial Product Revision

After conducting the initial field test, the results of the field test were obtained using the Si Tole game media that will be developed. The next step is for the researcher to revise the initial product of this game media. The steps taken by the researcher in revising the initial product include making revisions based on field tests and processing data on the results of the initial field test

4. CONCLUSION

Based from the findings of the study and debate conducted, it can be said that the Si Tole game media is suitable for use to improve students' critical thinking skills with valid, practical, and effective categories. The implementation of the Si Tole game media can be used in other schools, because it is not only practical in its use and storage, this game is also in the form of printed media, making it easier for schools that are limited in the use of electronic devices. However, the "Si Tole" game media is still limited to the Reaction Rate material, so it is hoped that in further research it can be developed with material that has characteristics to train students' critical thinking skills. As well as limitations in the initial field test, namely in

determining right or wrong answers has not been done automatically, so it is hoped that it can be a reference for further research to develop better products.

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