THE LEGEND OF THERMO GAME BASED COMPUTER AS LEARNING MEDIA ON THERMOCHEMISTRY FOR IMPROVING CURIOSITY ATTITUDE

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Abstract*. This research aims to obtain the learning media as a game that feasible for Thermochemistry matter. This study used Research and Development type with Borg and Gall model. This model has ten stages which are useful for producing a viable learning media. Feasible learning media require validity, practicality, and effectiveness. The validity score average on content and construct obtained 95.14% which very valid category. The media practicality assessment by students' responses using a questionnaire and obtained 86.26% which very practical category. The results of the effectiveness based on curiosity assessment of learning students obtained 90.33% which very effective category. The significant value of the pretest results obtained 0.200 and posttest results obtained 0.128 which is more than 0.05 so the data are normally distributed. In the Paired Sample t-Test obtained a significant value of 0,000 which is less than 0.05 so there is a significant difference between the pretest and posttest scores. Based on the explanation above, it is obtained a learning media as a game that feasible for Thermochemistry matter.*

Keywords: *Learning Media, Game, Curiosity, Thermochemistry*

INTRODUCTION

The education system is continuously changed by time and condition. The components involved in the education system changes are innovative education methods, education management, curriculum, educational facilities, and infrastructure. Curriculum changes at certain intervals times can achieve educational perfection. During the learning process, the curiosity of the students is expected highly based on the curriculum 2013 [1].

The best strategy is needed to manage the education system to achieve these goals. According to the report from the UNESCO conference in 1986, there are four pillars of education. This is a fundamental requirement for every student to study about learning to know, learning to do, learning to be, and learning to live together [2].

The implementation of learning to know as the pillar of education is created a curiosity attitude. Curiosity is a feeling that connects with scientific activities such as exploration, and investigation when learning [3]. Three theories causes of curiosity attitude, namely: (a) drive theory, (b) incongruity theories, and (c) information gap theory states that curiosity exists because of an affection centered on the inconsistency of information. Missing information can motivate someone to look for answers or it can be called an information gap [4].

Then the question is "How do teachers develop that attitude?" This can be facilitated by learning media as an effort to improve a curiosity attitude. Learning media as games in the learning process will be more attractive, the learning matter will be packaged attractively thus can be easily understood by students, moreover, the use of games can make students think critically when solved various events in the game.

Based on the pre-experiment research at MAN 1 Gresik, obtained 75% of students in one class had difficulty learning Thermochemistry matter. The students stated difficult because Thermochemistry is abstract, complicated to memorize, and need calculation. At MAN 1 Gresik, there were 56.25% of students state that difficult and

abstract matter and 43.75% of students had difficulty memorizing the matter, then as much as 96.88% of students stated that in the learning process using blackboard media, opposite with learning process using the game as media, 96.88% students states that they never experienced learning process using virtual games in Thermochemistry matter. Attractive game design could increase students' knowledge.

A game can create a pleasant learning atmosphere where students can learn while playing. Then the teacher can use games as learning media to improve curiosity attitudes and student learning outcomes. Learning objectives are based on the achievement of interest in learning or curiosity attitude and achievement of students' learning outcomes. These benefits can be obtained by using games as learning media [5]. Based on these explanations, researchers would like to develop a game named The Legend of Thermo as Thermochemistry learning media to improve students' curiosity attitude.

The Legend of Thermo game is a type of RPG (Role Playing Game). These characters can be changed by students as a player. Besides that, the narration is made to challenge the material that will be received by students, so that conscious participants will play while learning.

METHOD

The Borg and Gall R&D method has 10 steps [6]. The Borg and Gall model have 10 steps [7]. But in this research only limited only seventh step. The flow chart is illustrated in this following figure.

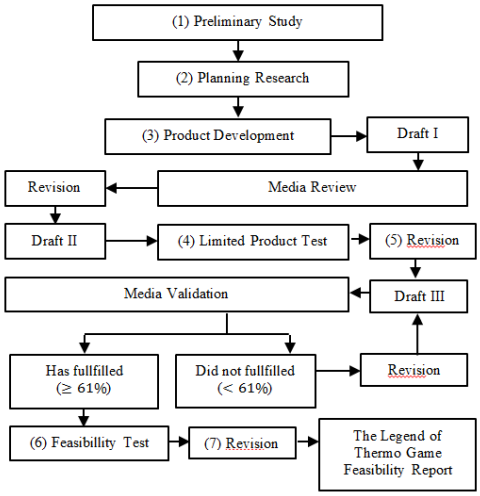

Figure 1. Media Development Flow Chart

Researcher using on group pretest-posttest design. Data collecting involved three lecturers to assess the validity and 15 students who require to participate learning process using a game. The pretest and posttest were done by an online base. In detail, the stages of research can be detailed as follows.

A. Preliminary Study

Literature study and field studies are a step at this stage. Literature and field studies have a function to obtain matter study, student character, school environment (facilities, media, and learning resources) and the condition of the teacher.

B. Planning Reseacrh

At this stage, information is gathered that can be used as a matter for the design of media products and instruments, such as (a) the objectives of learning games with KI, KD, and IPK; (b) appropriate matter; (c) pictures and music that are consistent with the matter concept.

C. Product Development

The product development includes several stages, namely: (a) product design as draft 1 of The Legend of Thermo media, (b) The review of drat 1 obtained suggestions and advice for media improvement to be analyzed descriptive qualitatively, (c) limited product tests and (d) validation.

Product validity is assessed by content validity and constructs validity which are assessed by one chemistry teacher and two chemistry lecturers. Then analyzed descriptive quantitative. The results of the validity of the game are analyzed by writing the presence or absence of each aspect expected with a score of 1 to 5 using a Likert scale in Table 1.

Table 1. Likert Score Scale

Score	Category
1	Very Bad
2	Bad
3	Less
4	Good
5	Very Good

The percentage of results are obtained using the following calculation:

$$\text{Percentage (\%)} = \frac{\text{Total score}}{\text{Criteria score}} \times 100\%$$

The criteria score uses the following calculation formula:

Criteria score = highest score x ∑ aspect x ∑ validator.

Interpretation of scores with a large percentage of ratings shown in Table 2.

Table 2. Score Interpretation Criteria

Percentage (%)	Criteria
0-20	Invalid
21-40	Less Valid
41-60	Valid Enough
61-80	Valid
81-100	Very Valid

Based on the criteria in Table 2, learning media can be tested if they get valid or very valid criteria with a percentage of ≥ 61%.

D. Feasibility Test

The revised results of draft III that already states as valid were tested on students. The test carried out the practicality and effectiveness of the developed game. Game testing is to know the practicality of game by students' response questionnaires and students' activities observation. Students' response questionnaire contains responses to the use of games during learning. These results then calculated based on the Guttman scale score in Table 3.

Table 3. Guttman Score Scale

Statement	Score Positive Statement	Score Negative Statement
Yes	1	0
No	0	1

The percentage of results in this calculation use the following formula:

$$\text{Percentage (\%)} = \frac{\sum \text{response every aspect}}{\sum \text{response of all students}} \times 100\%$$

The result of students' response questionnaires of students was analyzed as a determinant of the practicality of the game. The interpretation of scores with a large percentage of grading is shown in Table 4.

Table 4. Score Interpretation Criteria

Percentage (%)	Criteria
0-20	Not Practical
21-40	Less Practical
41-60	Practical Enough
61-80	Practical
81-100	Very Practical

Based on the criteria in Table 4, learning media can be said to be practical if getting a percentage of ≥ 61%.

Effectiveness is based on curiosity attitude and student learning outcomes. The results of the game curiosity attitude were analyzed by writing the presence or absence of each aspect expected with a score of 1 to 5 using a Likert scale in Table 5.

Table 5. Likert Score Scale

Score	Category
1	Very Disagree
2	Disagree
3	Ordinary
4	Agree
5	Very Agree

The percentage of results in this calculation use the following formula:

$$\text{Percentage (\%)} = \frac{\sum \text{All aspects score}}{\sum \text{maximum score}} \times 100\%$$

Criteria score is obtained through calculation as follows:

The results of the curiosity attitude questionnaire analysis are used to determine the effectiveness of the game improved the students' curiosity attitude by the interpretation of scores with a large percentage shown in Table 6.

Table 6. Score Interpretation Criteria

Percentage (%)	Criteria
0-20	Not Effective
21-40	Less Effective
41-60	Effective Enough
61-80	Effective
81-100	Very Effective

The developed game state effective if the average score is ≥ 61 or the category is effective or very effective.

Students' learning outcomes are complete if a minimum value of 75 is obtained. The following formula for calculating the value of learning outcomes:

$$\text{Value} = \sum \text{correct question} \times 10$$

The formula used in the calculation of the percentage of completeness in classical learning outcomes are:

$$\% \text{ classical} = \frac{\sum \text{students complete}}{\sum \text{all student}} \times 100\%$$

The results of the data from the learning outcomes of students are analyzed to determine the effectiveness of the game. Interpretation of scores with a large percentage shown in Table 7.

Tabel 7. Score Interpretation Criteria

Percentage (%)	Criteria
0-20	Not Effective
21-40	Less Effective
41-60	Effective Enough
61-80	Effective
81-100	Very Effective

The game that has been developed states effective if the percentage of the number of students who have completed reaches ≥ 61%.

SPSS version 22 software is used to test normality and paired sample t-Test on student learning outcomes. Data is normally distributed or not based on normality test results. Data is not normally distributed if a significant value < 0.05 is obtained and data is normally distributed if a significant value > 0.05 is obtained. A paired sample t-Test was used to find out that there were significant differences between student learning outcomes. There are significant differences in student learning outcomes if a significant value < 0.05 is obtained and there is no significant difference in student learning outcomes if a significant value > 0.05 is obtained. Learning media is feasible if it fulfilled three criteria, namely: (a) content validity and construct validity, (b) practicality, and (c) effectiveness [8].

RESULTS AND DISCUSSION

This stage will explain the data obtained during the development of The Legend of Thermo game on Thermochemistry matter. The results and discussion are only on the feasibility.

A. Validation of the Game

The validity of the game was assessed by one chemistry teacher and two chemistry lecturers. The following are the results of the game validity of the three validators described in Table 8.

Table 8. Game Validity Results

Nu.	Aspect	Percentage and Category
1	Content Validity	
	The truth concept	100% (very valid)
	The learning objectives	100% (very valid)
	Average	100% (very valid)
2	Construct Validity	
	Chemistry characteristics	80% (valid)
	Encourage developing skills	80% (very valid)
	Appropiate with the characteristics of students	100% (very valid)
	The gamerules	100% (very valid)
	The direction	90% (very valid)
	There are competition, requirements and strategies in playing	86,66% (very valid)
	There are standards for the success of students	100% (very valid)
	Challenging and actively involving students	80% (valid)
	Give feedback	93,33% (very valid)
	There are aspects of making decision	90% (very valid)
	Display of color, graphic size, and animation	93,33% (very valid)
	Audio visual communication	90% (very valid)
	Average	90,28% (very valid)

Based on Table 8 can be seen for the results of the content validity obtaining a percentage of 100% for each aspect of the truth concept and the learning objectives. Therefore, each of the aspects included in the very valid category because it gets a percentage of validity in the range of 81% - 100%.

This shows that the concept of Thermochemistry matter is correct following the applicable curriculum which is an indicator of the concept truth aspect. Achievement of competencies must be relevant to the use of instructional media based on the applicable curriculum [9]. Whereas for learning purposes and the IPK is appropriate which is an indicator of aspects having objectives. Students must have the achievement of learning objectives when used in learning media [10].

The construct validity consists of 12 aspects obtaining a percentage of 80% -100%. The highest value is found in the aspect of appropriate with the characteristics of students, has rules, and has a standard of success of students with a percentage of 100% in the very valid category. This confirms that The Legend of Thermo game is based on age and learning style so that it matches the characteristics of the students. Each student has a different learning style that is useful for learning, processing, and communication [11]. Next is the appearance of The Legend of Thermo game.

Figure 2. Appearance of The Legend of Thermo

Then in The Legend of Thermo game, there are contain rules and guidelines when students play. Following the rules to achieve certain goals and interact with other players in a contest is the understanding of the game [12]. However, for the standard aspects of students' achievement, it can be seen that there are requirements to proceed to the next chapter. This game has a requirement to move on to the next chapter where the player must answer 3-4 questions correctly and defeat the boss in that chapter. A game must have a standard for winning the game [13].

Based on Table 8 The Legend of Thermo game is validly used as a learning media because it gets a percentage value of 80% -100% in the very valid category. This means that The Legend of Thermo game as a learning media fulfilled the criteria of validity both content and construct as a learning media.

B. Practicality of the Game

The results of the students' response quest and students' activities observation are used to determine the practicality of The Legend of Thermo game. The following results of the questionnaire responses of students are seen in Table 9.

Table 9. Questionnaire Responses Result

Nu.	Aspect	Percentage and Category
1	Interest in games as learning media	88% (very practical)
2	The novelty of the game	70,1% (practical)
3	Usefulness of the game	88,8% (very practical)
4	Ease in using the game	84,4% (very practical)
5	Language in the game	100% (very practical)
	Average	86,26% (very practical)

Based on Table 9, it can be seen that the students' response obtain 70.1% -100% so that game The Legend of Thermo state practical.

In the first aspect get a percentage of 88% with a very practical category, namely an interest in games as a learning media. This is supported by the results of a questionnaire response that states students do not feel bored, challenged, interested, and happy with The Legend of Thermo game. Learning media that contain education and entertainment (edutainment) can be easily accepted by students. Edutainment can strengthen the fundamental aspects of learning that influence the development of generic skills and enable education based on social constructivist theory. The use of instructional media enables bridging the gap between theory and practice by providing opportunities to gather, share knowledge, and provide authentic contexts and activities for learning while doing [14].

In the second aspect, namely the renewal of the game the lowest results obtained from the response of students by 70.01% with the practical category. This is because many students are not familiar with RPG types, but Mini-Games like Hago are often played by students. This is consistent with the statement that the success of the game depends on how well they are designed. The same thing applies to educational games. Players must find how to improve their problem-solving skills when playing games. More successful educational games can be made, designers just need to be aware of how their choices affect the value of educational games [15].

In the third aspect, the usefulness of the game obtained 88.8%, so it was included in the very practical category. This is by the results of the questionnaire responses which state that students get a more pleasant learning atmosphere, use laptops to play while learning, be motivated to learn, and are helped in understanding Thermochemistry matter. A good learning media can help users or players to understand the lessons contained considering the flow of use in the media. The programmer considers the game. Then, they break the game down into sections and decide on each piece of content [16,17].

In the fourth aspect, the ease of using the game obtained 84.4%, with a very practical category. This is by the results of the questionnaire responses that explain students no difficulty when installing the game, there are instructions and guidelines in the game. The direction as feedback available from start to finish so the users or players can use the media smoothly. Appropriate and contextual feedback helps learners truly learn and achieve educational goals and play goals [18,19].

In the fifth aspect, namely language in the game obtained 100% with a very practical category. The use of language in this media is synchronous with good language rules and easy to understand. The use of language and terms in learning media must be easy to understand based on the level of knowledge and age of students [20].

The result data from students 'responses are supported by data students' activities observation obtained from interactions during the students' used games through the WhatsApp application. The results obtained that no one asked about The Legend of Thermo game which means students have understood the flow of this game. This is caused by the existence of guidelines and rules contained in the game or game guide book. The game guide book is given before students use the game. The making of a guidebook serves as a tool for teachers and students in used media [21].

Based on Table 9, The Legend of Thermo game is practically used as a learning media because the value obtained is ≥ 61 with a value of 70.1% -100%. This means that The Legend of Thermo game as a learning media has fulfilled the practicality criteria.

C. Effectiveness of the Game

The effectiveness of The Legend of Thermo game is obtained from the results of the curiosity attitude and student learning outcomes. The following results of students' curiosity attitudes can be seen in Table 10.

Table 10. Student Curiosity Attitude Results

Nu.	Aspect	Percentage (%)	
		Pretest	Postest
1	Discover	81,33	88
2	Explorer	78,66	94
3	Adventurous	64,66	92
4	Information Gap	72,66	86,66
	Average	74,33	90,33

Based on Table 10 it can be seen that for the results of curiosity attitudes students get a percentage of 72.66% -81.33% for the pretest and 86.66-94% for the posttest.

In the discover aspect it increased from 81.33 to 88%. These results indicate that students look for information other than the handbook and used media so that students get a broad understanding of Thermochemistry matter.

In the explorer aspect, it increased from 78.66% to 94%. This shows that during used this game students want to see all the matter in the media so that it can be said that the information or matter contained in the media is considered important by students.

In the adventurous aspect, the greatest increase was from 64.66% to 92%. This is caused by the matter on the media easily understood by students and there is a relationship between the previous matter (Hydrocarbons) with Thermochemistry matter

so that students can easily understand new concepts.

In the information gap aspect, it increased from 72.66% to 86.66%. This shows that there is a conflict with the concept that is already known by students. However, students find justification for new concepts that make students affected in getting lost information. So the results of curiosity attitudes of students get an average percentage of 90.33% and it can be said that the media of The Legend of Thermo is very effective in increasing the curiosity attitude of students. Curiosity attitude is a fundamental ability that must be possessed to encourage people to become lifelong learners. Curiosity attitude can open thinking, produce learning findings, and always develop [22]. Data on student curiosity attitudes are supported by data on student learning outcomes which can be seen in Table 11.

Table 11. Student Learning Outcomes Result

Condition	Average score	Lowest score	Highest score
Pretest	44,66	10	80
Postest	86	70	100

Based on Table 11, classical students' completeness was calculated and found 13.33% for the pretest and 100% for the posttest so that it can be said an increase in individual student learning outcomes after using the game The Legend of Thermo. Games can improve student learning outcomes [23].

Then the pretest and posttest score data analyzed using the normality test and paired sample t-Test. IBM SPSS Statistics 22 software is used with a significance level of 5% in the Shapiro-Wilk normality test analysis. The results of the normality test can be seen in Table 12.

Table 12. Shapiro-Wilk Normality Test

	Shapiro-Wilk		
	Statistic	Df	Sig.
Pretest	.914	15	.157
Postest	.896	15	.082

Based on Table 12, the results are normally distributed data based on significant pretest values of 0.157 and posttest of 0.082. This value > 0.05 so that paired sample t-Tests can be performed. Paired sample t-Test analysis with a significance level of 5%. The test results can be seen in Table 13.

Table 13. Paired Sample t-Test Result

	t	Df	Sig. (2-tailed)
Pair 1 Pretest-Posttest	-5.998	14	.000

Based on Table 13 obtained a significant value of 0.000. Where the value is < 0.05 so that it can be said there are significant differences in the pretest and posttest scores, which means The Legend of Thermo game increased student learning outcomes. The game can reach the classical completeness of students and there are significant differences between the pretest score and posttest score [24]. Based on the results above the learning media in the form of The Legend of Thermo game can support students learning Chemistry matter, namely Thermochemistry. Learning media is needed when face-to-face learning cannot be implemented so that it can replace the teacher's role.

Learning media can improve students' curiosity attitudes and make learning fun. Curiosity attitude can give enthusiasm in finding new knowledge both during chemistry learning or outside class hours. This knowledge search can be in the form of the act of asking a friend or teacher and searching online. The attitude of curiosity increased arises when there is a difference between initial knowledge and knowledge that has just been received. This can form a new concept and a broad understanding of that knowledge. These results are consistent with relevant research that the use of games as a media for chemistry learning can provide pleasant processes in learning chemistry, student-centered learning, can achieve mastery of learning, and can motivate students to study chemistry [25].

These results indicate that The Legend of Thermo game is effective as a learning media to improve curiosity attitudes and student learning outcomes on Thermochemistry matter. Learning media are said to be feasible and fulfilled three criteria,

namely: (a) content and construct validity, (b) practicality, and (c) effectiveness.

CONCLUSIONS AND SUGGESTIONS

Based on the aims and results of the discussion regarding the development of The Legend of Thermo game as a learning media on Thermochemistry matter it can be concluded that:

1. The Legend of Thermo as a learning media on Thermochemistry matter state as valid proven by the aspect of validity is very valid. Based on the results of the validator's assessment obtained results of 100% and 90.28% include content validity and construct validity with an average validity of 95.14%.
2. The Legend of Thermo game as a learning media on Thermochemistry matter state as practical proven by the aspect of practical is very practical. Based on the percentage value of 86.26% with a very practical category for the response results and supported by the students' observations.
3. The Legend of Thermo game as a learning media on Thermochemistry matter state as effective in terms of the results proven by curiosity attitude and completeness of students. The result of curiosity attitude was 90.33% and classical completeness of students was 100% so that The Legend of Thermo game that was developed effectively could be used as a learning medium for students on Thermochemistry matter.

From the explanation above, The Legend of Thermo game is declared appropriate to be used as a learning media on Thermochemistry matter in terms of validity, practicality, and effectiveness. This media can be used by chemistry teachers in online learning where students get a pleasant learning atmosphere when learning while playing during this outbreak and can increase students' curiosity attitudes.

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