

CHIBO Adventure Games a Learning Media on Chemical Bond Matter for Senior High School

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Abstract—The research aims to get the feasibility of CHIBO Adventure game as a learning media on chemical bond matter for senior high school. The research method uses Research and Development (R&D) done until limited testing phase. The test was conducted to 30 students of 10th grade of SMA Negeri 1 Manyar-Gresik. Feasibility of a game based on the aspects of validity, practicality, and effectiveness. The validity aspects is obtained from the validity assessment by validator consisting of two chemistry lecturers and one chemistry teacher. Practicability aspects are obtained from student activities observations and student response questionnaire. Effectiveness aspect obtained from learning outcomes and student learning motivation. The results of the content validity obtained range percentage 86%-93% in a very valid category and construct validity obtained in the range of 66%-100% in a valid and very valid category. The results of student activities observations obtained range percentages 83% to 100% in very good categories and the results of student responses questionnaire obtained range percentages 83%-100% in very good categories. Students learning outcomes obtained classical completeness get percentage of 100% and the results of student learning motivation questionnaires obtained a percentage of 83%-93% in a very good category. Based on the results of the research, the CHIBO Adventure game is feasible as learning media in chemical bond matter for high school students.

Keywords—*CHIBO Adventure Game, Learning Media, Chemical Bond*

I. INTRODUCTION

The 21st century paradigm is emphasizing students in critical thinking, able to develop science with real-world also a master of information technology [1]. The principle of learning with information technology utilization on permendikbud no. 22 years 2016 to increase the learning effectiveness. Effective learning is learning by engaging student activities to achieve optimal learning [2].

The use of media technology can increase the learning effectiveness if it is supported by active learning. Active learning characteristics based on Permendikbud no. 103 year 2014 that are interactive and inspiring, as well as a fun, challenging and motivating students to participate actively in learning. In education, motivation is considered a key determinant of learning. It is used to explain the attention and effort students dedicate to particular learning activities [3]. Learning motivational aspects and learning outcomes have linkages very closely. Motivation and learning outcomes are inseparable and together. Without a

high learning motivation, it can be predicted that the study results achieved would be low [4].

Chemical bond material which is a chemical material grade X SMA/MA is concept with an abstract example so as to better understand these materials, students should be given audiovisual media for visualizing chemical bonds are formed also try to solve many exercises. Based on initial research stating that 100% of the students are difficult to understand the chemical bond material. This material requires a good understanding so that it takes the learning media representative and can be repeated at any time.

The existence of media according to Shelawati make the students more easily understand the abstract nature of the material [5]. According to Ely, the selection of the learning media must be aligned with the objectives, contents and characteristics of students [6]. One of the media learning that can arouse desire, motivation and ease to understand chemical materials form of concept with an abstract example in which finally was able to improve the students learning results is a game. According to Frietes, Reiber, Noah&Ting said that games are considered useful instruments for acquiring knowledge [7]. Based on initial research States that 88% of the students agree in chemical teaching and learning using computer-based games as a media of learning-themed adventure. CHIBO Adventure game is a game based computer themed adventure. This game develops specific skills in a game of chemical bonding material than any previous material chemical bond game that is try their skill in critical thinking through HOTS question. According to Lewis and Smith regarding higher-order thinking (Higher Order Thinking Skill) includes critical thinking, creative thinking, problem solving and decision making. High-level thinking (HOTS) occurs when someone gets new information and stores it in memory. Then, the information is interrelated to get answers to confusing situations [8].

According to Hamdani, the use of games in learning can create creative experience, give interesting experience for students understand concepts, strengthen the concept that has been understood, or solve the problem, and increase intrinsic motivation to students [9]. According to Ardan, the use of games as learning media can also improve student learning outcomes [10].

Therefore, it's necessary to develop game as learning media on Chemical Bond matter that can enhance motivation to students and the learning outcome of students

that is a game of CHIBO Adventure. Based on the description above, the purpose of this research is to obtain a feasible CHIBO Adventure game as a learning media that is viewed from criteria of validity, practicality, and effectiveness.

II. METHOD

This research is type of development research using Research and Development (R&D) methods. The research method includes the introduction stage and development stage. Each stage will be explained as follows.

A. Introduction Stages

This stage is development early stage that consists of three steps, namely literature study, field survey and preparation of product.

- Literature study is the learning theories study that supports the game development.
- Field survey conducted through the pre-research to students class XI in SMA Negeri 1 Manyar, Gresik. The questionnaire results get 100% students expressed the difficulty in learning the chemical bonds material form concepts with abstract examples. Therefore, necessary audiovisual media for visualizing chemical bonds are formed also try to solve many exercises.
- Preparation of draft product aims to produce CHIBO Adventure game as learning media. The preparation stage of a draft product, i.e.
 - 1) Game Planning, this is done to obtain the initial draft of the game.
 - 2) Game Review will be reviewed by a chemical lecturer to obtain comments and suggestions as the initial draft of the game. Game review using the review sheet instrument.
 - 3) Improvements after a game review, this was done based on the suggestions and comments from chemical lecturer.
 - 4) Game validity will be validated by the experts, consisting of two chemical lecturer and one chemistry teacher. The validity of the game consists of two aspects, namely the content validity and construct validity. The game validity using the validation sheets instrument. The score is based on the Likert scale on Table 1

TABLE I. LIKERT SCALE SCORE

Statement	Score
Very less	1
Less	2
Enough	3
Good	4
Very Good	5

[11]

The results of the assesment are analyzed in each indicator with the formula:

$$\text{Validity percentage} = \frac{\text{total score of each indicator}}{\text{total number of indicators}} \times 100\%$$

Criterion score = highest score x number of validators

The game is valid if each indicator on the validity aspects of the game gets percentage result $\geq 61\%$ [11] in valid to very valid criteria.

Improvements after game validity. If there is something wrong or less on games or not yet get validity criteria.

B. Development Stages

The development stage is the game trial phase which includes two steps, namely limited trials and wider trials. In this study, limited trials were conducted. The game testis done to 30 students of class X MIPA 7 in SMA 1 Manyar, Gresik using One Group Pretest-Posttest Design, namely the students before conducting learning activities, given pretest questions that used to obtain students' mastery learning before using learning Media. Furthermore, a trial of the CHIBO Adventure game was conducted as a learning media for Chemical Bondmatter. The student activity observed durig game trial. Then, student are given post-test questions to obtain student learning outcomes after using learning media. After that, student are given student response questionnaire and student learning motivation questionnaires. The game trials were analyzed to obtain the practicality and effectiveness of the CHIBO Adventure game which was developed as a learning media for Chemical Bond matter for high school students. The practicality

1) Student Activities Observation

Student activities during game trial observed using student activity sheet instruments. The results of the students activity are analyzed using the formula.

$$PP = \frac{\text{total score}}{\text{number of respondent}} \times 100\%$$

Information :

PP = percentage of practicality

The game is practical when activity students assessment gets percentage $\geq 61\%$.

2) Student response questionnaire

Student response questionnaire there are positive and negative statements. The score is based on the Guttman scale score on Table 2.

TABLE II. GUTTMAN SCALE SCORE

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

[11]

The data obtained will be analyzed using the formula :

$$PP = \frac{\text{number score each question}}{\text{number of respondents}} \times 100\%$$

Information :

PP = percentage of practicality

The game is practical if gets the percentage of $\geq 61\%$ in practical to very practical category.

2.2.1. Effectiveness

1) Student learning outcomes

Student learning outcomes obtained using sheets of pretest and post-test to measure student learning completeness before and after using the game. The results of the study were analyzed by using a formula.

$$CC = \frac{\text{total number of students completed}}{\text{number of students}} \times 100\%$$

Information :
CC = classical completeness

The game is effective if in individual learning completeness get score >75 and classical completeness get of > 85% [11].

2) Student learning motivation questionnaires

The results of the students learning motivation questionnaires analyzed by quantitative descriptive. The data obtained will be analyzed using the formula:

$$PE = \frac{\text{number score each statement}}{\text{number of respondents}} \times 100\%$$

Information :

PP = percentage of effectiveness

The game is effective if the learning motivation assessment get percentage $\geq 61\%$.

III. RESULT AND DISCUSSION

The result of the research and discussion on the development of CHIBO Adventure are described as follows.

A. Introduction Stages

a. Game Review

At this stage, the game initial draft were reviewed by a chemical lecturer to obtain advice and comments in order to make the game in accordance with criteria that have been set. Researchers using methods examination questionnaire that is a game review sheet instrument.

b. Game Improvements

At this stage, improvement draft of the game was done from suggestions and comments obtained from the results of the game review by chemical lecturer. The following examples display of game before and after game improvement.



Fig 1. Display before improvement

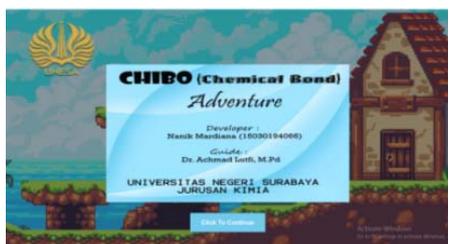


Fig 2. Display Display after improvement

c. Game validity

The results of the game validity conducted by experts, namely two chemical lecturer and a chemistry teacher consists of two aspects, namely the content validity and construct validity in Table 3 as follows.

TABLE III. THE RESULTS OF THE GAME VALIDITY

No	Aspects	Range percentages (%)
Content Validity		
1.	Concept of truth	86,67 %
2.	Have the purpose	93,33%
Construct Validity		
1.	The science characteristics	66,67
2.	Encouraging the development of special skills	86,67
3.	Conformity with the students characteristics	86,67-93,33
4.	Have rules	80-86,67
5.	Guiding character	93,33
6.	There is a standard of success	93,33
7.	Challenging and involving active students	100
8.	Provide feedback	86,67
9.	There are decisions making aspects	93,33
10.	The color displays, the graphics size and animation	73,33-86,67
11.	Audio visual communication	80-86,67

1. Content Validity

In the truth concept aspect CHIBO Adventure game obtained a validity percentage of 86.67% with a very valid category, meaning that the chemical bond material was correct and in accordance with scientific rules. In this aspect obtained the lowest validity percentage of validity content because the limited chemical bond material discussed in the CHIBO Adventure game is covalent bond material.

The aspect of having goals with assessment indicator is material in the game in accordance with the chemistry objectives obtained a validity percentage of 93.33% with a very valid category. When the media is precisely in accordance with the objectives, it is able to improve the learning experience of students so that they can improve learning outcomes [13].

2. Construct Validity

a) Science Characteristics

In the science characteristics of the CHIBO Adventure game obtained a validity percentage of 66.67% with a valid category. Assessment indicator is investigative activities which mean that there is an investigation activity in the form of answering a question by observing the question date given and determining the appropriate answer. The investigation aims to develop problem-solving skills through the stages of identifying problems, formulating problems, designing ways of solving problems, applying, analyzing and evaluating the results [14]. In this

game, the investigation stages carried out are more dominant in analyzing the questions and evaluating the questions given, then answering the questions correctly.

b) Encouraging the development of Special Skills

In this aspect, the assessment indicators for training critical thinking on HOTS questions obtained a percentage of 86.67% with a very valid category. Critical thinking skills namely the skill of giving wise judgments and critiquing something using logical and scientific reasons [15]. The HOTS question according to Bloom, Englehart, Furst, Hill & Krathwohl consists of cognitive levels that are analyzing, synthesizing and evaluating [16]. The HOTS question in the CHIBO Adventure game encourages developing critical thinking skills through questions about analyzing cognitive (C4) and evaluating levels (C5).

c) Conformity with the student characteristics

In this aspect, the validity percentage ranges were 86.67%-93.33% with very valid categories. This aspect consists of 3 indicator components with the highest validity percentage on the indicator according to the student age which is obtained a percentage of 93.33% with a very valid category. High school students have ages between 16-18 years which are cognitively be the formal operational stage [17]. At the formal operational stage, children are able to think abstractly [18]. Chemical Bonds material in class X SMA is material in the concepts form with abstract examples so that they fit the characteristics of students.

d) Have rules

In this aspect, the validity percentage ranges from 80% to 86.67% with valid and very valid categories. In this aspect there are two indicators, namely there are guidelines or rules of the game and clarity of the game instructions. Each game has four components and one of them is the rules of the game [6]. McGonigal stated that rules in games are the limits of how players achieve goals in the game. The existence of rules encourages players to explore various ways to realize their goals [19].

f) Guiding Character

In this aspect with the assessment indicator there is a material menu in the game to guide in completing the game get the validity percentage of 93.33% with very valid criteria. The guiding game is shown in the material menu in the main menu of the game as the first step for the player to remember the chemical bond material that has been studied before. Then, at each level, if the player is wrong in answering, then there is material presented as guidance in solving the game problem.

g) There are Standards of Success

In this aspect, assessment indicators namely there are terms to continue the next level, the validity percentage is 93.33% with very valid category. In the CHIBO Adventure game, player is said to succeed at each level when players can collect eight CHIBO words by answering the questions given correctly, answering star questions which are extra questions with the HOTS (Higher Order Thinking Skill) questions level, and collecting all elements so that the video formation of covalent compounds can be displayed.

h) Challenging and involving active students

In this aspect, the assessment indicators are challenging students to play while learning get 100% validity percentage with a very valid category. Game development according to Romlah is the element of competition in the game [20]. Elements of competition cause the game to be more interesting [6].

i) Provide Feedback

In this aspect with two assessment indicators, there is a penalty for failing get a percentage of 86.67% with a very valid category and there is a prize if player gets success obtaining a percentage of 86.67% with a very valid category. In the CHIBO Adventure game, if the player succeeds in answering correctly then, additional points are obtained, but when answering incorrectly there is a reduction in points. The game provides direct feedback so as to enable a more effective learning process to occur [6].

j) There are Decisions Making Aspects

In this aspect the assessment indicators are choices in answering or stepping in the play get the validity percentage of 93.33% with very valid category. In the main menu consists of an instruction, games and material menu. Players can choose that firstly menu that want to open. Furthermore the game type to find answer from the question given. Players can determine the correct answer. While playing, students can also make decisions in continuing the game, repeat playing levels or return to the game's main menu.

k) Display color, graphic size and animation.

In this aspect the validity percentage range was 73.33%-86.67%. There are three indicators, the colors used in accordance with the background, the animation used in accordance with the game content, and the font size can be used clearly. In the third indicator the percentage is 73.33% with a valid category because the font size of CHIBO's writing on the CHIBO questions and the element letters at each level are too small and the letter design used is not clearly visible when CHIBO's writing is in a tree background. Therefore repairs are carried out. Interactive learning is able to enable students to learn with high motivation because of their interest in multimedia systems that are able to present the appearance of text, images, sound videos and animations [21].

l) Audio visual communication.

In this aspect, the validity percentage ranges from 80% to 86.67% with valid and very valid categories. The first assessment indicator, there is a link between narration and music, and gets a percentage of 86.67% with a very valid category. When using background music, music must be chosen according to the atmosphere created [6]. In the indicator there is a suitability between the background design and the text placement and color by 80% with a valid category by giving suggestions by the validator on the text placement and the word CHIBO color in the game.

B. Development Stage

The development stage is the stage of game trial. In this study was only carried out until limited trial stage/ the trial was conducted to determine the feasibility of the game CHIBO Adventure especially on practicality and effectiveness aspect as learning media.

a. Practicability of CHIBO Adventure Game

In this study, the practicality of the game seen from the results of the student responses questionnaire was supported by observational data on the students activities while using the CHIBO Adventure game.

Data on student response results are presented in Table 4.

TABLE IV. RESULT OF RESPONSE OF STUDENTS

No	Aspect	Percentage Range
1.	Game interest	83.3%-100%
2.	Material clarity	83,33%-96,67%
3.	Ease of Use	93,33%-96,67%

1) Obtaining Student Interest Levels in Games as Learning Media.

The results of the questionnaire responses in the game interest aspect were obtained in the range of 83.3% - 100%. The results of the response questionnaire received a percentage of 100% on the statement CHIBO Adventure game is a fun learning media. This is supported by the student activities who can complete each game level by completing each game level with activity percentage of 100%. Game based learning is very interesting because players must learn what is needed to overcome problems and finally be able to complete the game [22]. Learning with a new thing in a fun way can make you more enthusiastic in learning [23].

2) Obtaining Level of Material Clarity in Games as Learning Media.

The results of the responses questionnaire on material clarity aspects obtained a percentage range of 83.33%-96.67%. The results of the students' responses questionnaire found that 96.67% of students agreed that the CHIBO Adventure game helped students understand chemical bond matter the covalent bond sub matter. This is supported by the student activities in completing each game level by solving on the game questions correctly. The media is able to attract the student attention to pay attention to the lesson and play an active role in the learning process, so that students will more easily understand and understand Chemical material which will later have a positive impact on learning outcomes [20].

3) Describe the Game Use Ease in Operation as a Learning Media.

The results of the responses questionnaire on aspects the game use ease obtained a percentage of 96.67% of students easy to operate the game CHIBO Adventure and 93.33% of students easily understood the game rules and the steps to game completion. One of the factors considered in the media selection is practical or easy to use [24]. The game use ease of CHIBO Adventure game because has been provided game guide book which is shared to students so that they can guide students in the operation of the game.

b. Effectiveness of CHIBO Adventure Game

The effectiveness of the CHIBO Adventure game was reviewed of learning outcomes and questionnaire for learning motivation. The result were described as follows.

1) Result of Students Learning Outcomes

Students learning outcomes are obtained through the pretest and post-test results. The students learning outcomes at the pretest and post-test are shown in Table 5.

TABLE V. STUDENTS LEARNING OUTCOMES

Learning Outcomes	Completeness Number	Completeness Percentage
Pretest	2	6,67%
Posttest	30	100%

The results of the pretest compared to the post-test have an increase in the completeness number after the trial CHIBO Adventure game as a learning media in the Chemical Bond matter Covalent Bonds material Sub Matter. This shows that the CHIBO Adventure game has an influence on student learning outcomes. Learning outcomes are got to be completed if they get a score of ≥ 75 and classical completeness is set at $\geq 85\%$ [12]. Based on Table 5, the overall post-test results were declared complete or scored ≥ 75 and classical completeness was 100%. Educational games is one of game form that can be useful to support the teaching and learning process in a more fun and more creative way [25]. Fun learning is supported by the instructions and rules of the game in the learning context [21].

2) Result of Questionnaire for Learning Motivation for Students

The results of the student learning motivation questionnaire in each indicator can be seen in Table 6.

TABLE VI. RESULTS OF LEARNING MOTIVATION QUESTIONNAIRE

Indicator	Percentage Range
Motivation to study chemical bond matter	83%-93%
Motivation to hard work on the assignment given	83%
Feel motivated to learn to use games during the learning process	86%-93%
Feel happy when succeeding in the game	93%

a) Motivation for Studying Chemical Bond Matter

The first indicator of the motivation questionnaire was the motivation to study chemical bond matter consisting of three statements with a percentage range of 83% -93% with a very good category. In the first statement, I was motivated to study chemical bond matter with a percentage of 86.67% with a very good category. This is supported by the student responses questionnaire with the criteria of the CHIBO Adventure game to help understand Chemical Bonds matter of the Covalent Bond sub matter with the percentage of 96.67% with very good categories. In addition, the results of student activities observations in the steps of game in answering the questions correctly obtained an activity percentage 100%. This is in accordance with Arsyad's statement on the use of learning media in the teaching and learning process can generate new interests and desires, arouse motivation and

stimulation of learning activities, and even bring psychological influences to students [26]. Therefore, the CHIBO Adventure game can provide motivation to learn Chemical Bond matter as a learning media.

b) Hard Work Motivation on Assigned Tasks

The second indicator is the motivation to hard work on the given task consisting of two statements with a percentage 83.33% with a very good category. The first statement is that I am motivated to work on the post-test question to find out my abilities and the second statement is that I am motivated to work on other questions about chemical bond matter. The first statement was proven by 100% of students completing the post-test questions. This is supported by the questionnaire response results that students are easy to do the post-test questions after using the CHIBO Adventure game with a percentage of 83.33%. Schrader and McCreey stated that there are three perspectives on games. One of the three perspectives offered is interactive tools, namely games that function as simulations and models that play a role in motivating players to achieve the tasks that assigned. Games play a role as a companion of cognitive processes that are able to produce changes in players [19]. Thus, the CHIBO Adventure game is an interactive tool in motivating students in the cognitive process to do the tasks that given.

c) Motivated Learning to use Games during the Learning Process

The third indicator is the motivation to learn use the game during the learning process. There are two statements with the acquisition of the percentage range 86%-93% with very good categories. The first statement is that I feel motivated to learn use games to get a percentage of 86.67% with a very good category. This was supported by the students responses questionnaire that the CHIBO Adventure game was a fun learning media with a percentage gain of 100% with a very good category. This is supported by the video covalent compounds formation in the CHIBO Adventure game and based on observation of student activities, it was found that 100% of students opened the video. With the presence of interesting videos on the game, the game becomes more fun and students can be motivated to learn use the game during the learning process

The second statement is that I feel motivated to answer on CHIBO questions correctly to get the best points by getting a percentage of 93.33% with a very good category. This is supported by the student responses questionnaire results that the game CHIBO Adventure is a fun game with a percentage gain of 100% with very good criteria. This is evidenced by students being able to answer CHIBO questions at each level with a percentage gain of 100% even though there are some students who do repetitions answering questions because they are wrong. When playing, players sustain errors in answering. According to Inal & Cagily stated that mistakes when playing can be a self-reflection approach to reuse play strategies so as to increase knowledge and self-motivation to try again [27].

d) Feel happy when succeeding in the game

The fourth indicator is feeling happy when succeeding in the game with a statement I feel happy when successfully completing each level with the effectiveness acquisition percentage of 93.33% with a very good category. Through the CHIBO Adventure game, players feel happy when they successfully complete each level of the game. This is supported by Eseryel and Ge's statement regarding the game can give pleasure to players through the play button function in educational interests [19].

IV. CONCLUSION

Based on research data that has been done, CHIBO Adventure game is worthy of being used as a learning media in chemical bond matter. This is based on the achievement of the feasibility aspects as follows.

- Validity criteria by obtaining percentages in the range 86%-93% for content validity in very valid criteria and 66%-100% for construct validity with valid and very valid criteria.
- Practicality criteria of student activities by obtaining a percentage of 83%-100% with a very practice category and student responses questionnaire by obtaining a percentage of 83% -100% with very practice category.
- Effectiveness criteria of student learning outcomes get a percentage of 100% classical completeness and student learning motivation questionnaire obtain a percentage of 83%-93% with very good category.

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