

CHAPTER III METHODOLOGY

3.1 Method

The method used in this research is a descriptive method. This method described as a very detailed and careful statements given (Fraenkel, Wallen, & Hyun, 2012). Omair (2015) Stated that the descriptive method is useful to describe the study characteristics and generalize findings. There will be no comparison in this method.

The example of a descriptive method in educational research is using the survey as the example. The descriptive method also has a function to describe the behaviors of teachers, administrators, or counselors, and parents, physical capabilities of schools. This method is appropriate for the research which is developing computer-assisted instruction by using gamification on mirror reflection topics in junior high school.

3.2 The Validators of the Research

The validators for this research consist of experts and students. The experts in this research are one science field expert, one media field expert, and one science teacher. The expert on science had an educational background until doctoral and has experience in teaching science. The expert on media had experience in being a lecturer for subjects media and robotics. The teacher on this research had a background of eight years experience teaching science in junior high school.

There are also fifty-seven students as another validator, that consist of 28 male students and 29 female students in 9 grades in one of junior high school. The location of research is one of school that adjusts technology as one of their subjects. Thus the students do not need to learn technology or computer from the very beginning again since this study has objective to adjust their learning and subject test. Data was taken in a computer laboratory in school which had nineteen computers available and can be normally operated.

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The choice of students uses simple random sampling in 9 grade at one of junior high school. The simple random sample is one of method stated that every member of the population has equal and independent chance of being selected. If there is a large sample, this method is the best way to get sample representation on population (Fraenkel, Wallen, & Hyun, 2012). The experts that were being asked to give their responses are expert on science, media, and teacher.

3.3 Operational Definition

In order to avoid misconception about this research, operational definitions are explained in this research. Those terminologies are explained as follow:

1. The development of the game is assisted by using the computer as the instruction. Computer-assisted instruction is a way to make the computer as a tool to create learning media. One of the type of CAI used is game. As in this research, the tool used is a computer that is available in junior high school for students to learn about physics material given. The process of creation of the game is using a software name construct 2. The game content created based on mirror reflection concept. The concept in this study is about flat, convex, and concave mirror characteristics and image formation in junior high school material based on Indonesian curriculum 2013.
2. Experts response was collected by using rubrics given to the experts. The aim of the rubrics is to assess the multimedia score to assist learning that consist of mechanical, multimedia elements, information structure, documentation, quality of content, and user survey.
3. Students' response was collected using rubrics. The rubrics are adapted from some research based on gamification. The gamification aspects which are difficulty level, error navigation, language error, clear screen design, level or challenge, contain mirror reflection concept, perception mirror reflection, clear goals. The effects of gamification

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focused in this research are motivation, joyness, convenience, addiction, perception mirror reflection, attractiveness, interactiveness.

3.4 Data Collection

The data is collected in the form of rubrics from experts and a survey from the students. The rubrics and survey have a scale, rating, and written review. The rubrics have one until four scales with each specific description on the scale. The survey was given both yes or no choice and level of agreement scale 1-5. The written review contains a form to put feedback, comment, opinion, and suggestions. In order to collect the data, the detail process is described as follow:

3.4.1 Experts

The rubric that consists of game, video explanation was directly given to three experts who are science, media, and teacher directly after the game created. The game was in the form of EXE type so the experts can try it directly. All of the experts were asked to play the game from computer and laptop, depend on the condition. Then, after trying one game, experts filled the rubrics given. Experts gave feedback and opinion written and verbal to the researcher while asking some questions for the clarity. The data collected from experts were in the form of scale and suggestions or comments regarding the aspects and general feedback towards the game.

3.4.2 Students

The output data collected from students are the percentage of yes/no, level of agreement, and written comment or feedbacks. The first process took the data that, the game and video manual were copied and tried one by one to seventeen computers in the school one day before taking the data. Students were being separated into three batches to collect fifty-seven data because of the computer limitation. Students got into the class, and the worksheet was given to each of the students. The worksheet consists of the manual to play the game and the

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questionnaire. Then, the researcher explained how to play the game each of the processes one by one using the video manual explanation in front of the class. Students were also explained how to fill the questions. After that, the students played the game by themselves. There were time differences for each student to finish the game. The students asked so many things in the middle of playing the game to the researcher. Then after all of the students finished the game, in around 30-45 minutes, the filled questionnaire was given back to the researcher. Data collected in the form of scale, ratings, and answer of quiz they answer in one worksheet for each student.

3.5 Data Analysis

The instrument used to obtain or gain data in this research to gather opinion, feedback, and satisfaction with using gamification aspects in learning light reflection. The instruments that used are the experts' judgment rubric and questionnaire for students.

3.5.1 Expert Rubric

The rubric was adapted from rubrics created by Multimedia Team at North Carolina State University (McCullen, et al., 2015). In order to check the development of learning, media created based on gamification aspect a multimedia rubrics consist of the indicator, criteria, and aspects for scale one until 4. The scale one until 4 has its category and definition for each criterion. Thus the expert can choose the most suitable point based on the condition of the game and their perspective. The detail rubrics is shown in Table 3.1 Expert's Rubric Scale.

The resulting score is taken from average for each scale that the result given by all of the experts. The average got from the total of the score given by all experts in each aspect and divided by three as number total of the experts by formula shown below.

$$\bar{X} = \frac{\sum X}{n}$$

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(Minium, King, & Bear, 1993)

That defined by, \bar{X} is mean of sthe ample. X is the score given by experts or sum of scores. n is total of the sample which is experts number.

Table 3.1
Experts' Judgment Rubric Scale

| No | Aspect | Criteria | Scale 1 | Scale 2 | Scale 3 | Scale 4 | Remark |
|----|------------|--------------------|--|---|---|---|--------|
| 1 | Mechanical | Technical | Game does not run satisfactorily. There are too many technical problems to view the Game. | The game runs minimally. There are many technical problems when viewing the Game. | The game runs adequately with minor technical problems. | Game runs perfectly with no technical problems. For example, there are no error messages, all sound, video, or other files are found. | |
| 2 | | Navigation | Buttons or navigational tools are absent or confusing. No buttons and navigational tools work. | Minimal difficulty experienced while navigating through Game. | Few difficulties experienced while navigating through Game. | Users can progress intuitively throughout the entire Game in a logical path to find information. All buttons and navigational tools work. | |
| 3 | | Spelling & Grammar | The game has multiple errors in spelling and/or grammar. (Four or more | Game minimally honors rules of spelling and/or grammar. (Three or less | Game adequately honors most rules of spelling and/or grammar. (Two or | Game honors all rules of spelling and/or grammar. | |

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| No | Aspect | Criteria | Scale 1 | Scale 2 | Scale 3 | Scale 4 | Remark |
|----|--------|---------------|--|--|---|--|--------|
| | | | errors) | errors) | less errors) | | |
| 4 | | Comple-tion | Game is incomplete and contains many unfinished elements. | Game is incomplete and contains some unfinished elements. | Game is incomplete and contains several unfinished elements. | Game is completely finished. | |
| 5 | | Screen Design | Screens are either barren and stark or confusing and cluttered. Exaggerated emphasis on graphics and special effects weakens the message and interferes with the communication of content and ideas. | Multimedia elements accompany content but there is little sign of mutual reinforcement. There is no attention to visual design criteria such as balance, proportion, harmony and restraint. There is some tendency toward random use of graphical elements that do | Multimedia elements and content combine to adequately deliver a high impact message with the elements and words reinforcing each other. | The combination of multimedia elements and content takes communication to a superior level. There is clear attention given to balance, proportion, harmony, and restraint. The synergy reaches the intended audience with style and pizzazz. | |

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| No | Aspect | Criteria | Scale 1 | Scale 2 | Scale 3 | Scale 4 | Remark |
|----|-----------------------|---------------------|--|---|---|---|--------|
| 6 | Information Structure | Use of Enhancements | No graphics, video, audio, or other enhancements are present or use of these tools is inappropriate. | not reinforce message. Limited graphics, video, audio, or others enhancements are present but do not always enrich the learning experience. In some instances, use of these enhancements is inappropriate. | Most graphics, video, audio, or other enhancements are used effectively to enrich the experience. For example, clips are either too long or too short to be meaningful. | All graphics, video, audio, or other enhancements are used effectively to enrich the learning experience. Enhancements contribute significantly to convey the intended meaning. | |
| 7 | | Organization | The sequence of information is not logical. Menus and paths to information are not evident. | The sequence of information is somewhat logical. Menus and paths are confusing and flawed. | The sequence of information is logical. Menus and paths to most information are clear and direct. | The sequence of information is logical and intuitive. Menus and paths to all information are clear and direct. | |
| 8 | | Branching | Game contains few well-choices. | Game contains few well-designed | Although Game contains some | Game is truly multimedia, rather than linear and | |

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| No | Aspect | Criteria | Scale 1 | Scale 2 | Scale 3 | Scale 4 | Remark |
|----|---------------|------------------------------------|--|--|--|---|--------|
| | | | The design is linear. | and age-appropriate choices. The design is primarily linear. | well-designed and age-appropriate choices, some portions are linear. | contains a significant number of well-designed and age-appropriate choices. | |
| 9 | Documentation | Citing Resources | No sources are properly cited. | Few sources are properly cited. | Most sources are properly cited. | All sources are properly cited. | |
| 10 | | Permissions Obtained for Resources | No permissions to use text, graphics, audio, video, etc. Are available. *** | Few permissions to use text, graphics, audio, video, etc. Are available. | Most permissions to use text, graphics, audio, video, etc. Are available. | All permissions to use text, graphics, audio, video, etc. Are available. | |
| 11 | | Originality | The work is a minimal collection or rehash of other people's ideas, products, images, and inventions. There is no evidence of new thought. | The work is an extensive collection and rehash of other people's ideas, products, images, and inventions. There is little evidence of new thought or | The Game shows some evidence of originality and inventiveness. While based on an extensive collection of other people's ideas, products, | The Game shows significant evidence of originality and inventiveness. The majority of the content and many of the ideas are fresh, original, and inventive. | |

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| No | Aspect | Criteria | Scale 1 | Scale 2 | Scale 3 | Scale 4 | Remark |
|----|--------|--|--|---|---|---|--------|
| | | | | inventive ness. | images, and inventions, the work extends beyond that collection to offer new insights. | | |
| 12 | | Curriculum Alignment (Objectives are clearly stated on Entry Form) | No evidence of connection to target curriculum. Users are not likely to learn from this Game. | Some evidence of connection to target curriculum. Users may learn from this Game. | Adequate evidence of connection to target curriculum. Users are likely to learn from this Game. | Clear evidence of connection to target curriculum. Frequent and clear references are made to facts, concepts, and cited resources. Users will learn from this Game. | |
| 13 | | Evidence That Objectives Were Met | No evidence that Game content supports stated objective s. | Little evidence that Game content supports stated objective s. | Some evidence that Game content supports stated objective s. | Clear evidence that Game content supports stated objectives. | |
| 14 | | Depth & Breadth of Game Content | No evidence that higher level thinking skills were | Little evidence that higher level thinking skills were | Some evidence that higher level thinking skills were | Clear evidence that higher level thinking skills were used in the creation of this Game. | |

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| No | Aspect | Criteria | Scale 1 | Scale 2 | Scale 3 | Scale 4 | Remark |
|----|--------|-------------------|--|--|---|---|--------|
| 15 | | Subject Knowledge | used in the creation of this Game. Subject knowledge is not evident. Information is confusing, incorrect, or flawed. | used in the creation of this Game. Some subject knowledge is evident. Some Information is confusing, incorrect, or flawed. | used in the creation of this Game. Subject knowledge is evident in much of the Game. Most information is clear, appropriate, and correct. | Subject knowledge is evident throughout the Game. All information is clear, appropriate, and correct. | |
| 16 | | User Survey | Items in the instrument are not clear enough to take data to the users | Items in the instrument are clear enough to take data to the users | Items in the instrument are clear enough to take data to the users and have aspects that measurable | Items in the instrument are clear enough to take data to the users and have aspects that measurable | |

(Source: McCullen, et al., 2015)

3.5.2 Scale for Students' Questionnaire

The rubric that used in this research is scale and ratings. The questionnaire is consist of eight aspects. The aspects were adapted from several studies that mentioned media aspects and gamification aspects which are Gambari & Yusuf (2014), Hamari, Koivisto, & Sarsa (2014), Zichermann & Cunningham, (2011), and Cheong, Filippou, & Cheong (2014) it has one question each, students need to answer yes if they found the aspect asked and answered no if they did not find it in the

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game. The first questionnaire is to check the availability of gamification and media aspects of the aspects mentioned to the students in Table 3.2.

Table 3.2
Students' Questionnaire on Media & Gamification Availability

| No. | Aspect | Questions | Yes/No |
|-----|-----------------------------------|--|--------|
| 1 | Difficulty level | <i>Apakah kamu menemukan banyak kesulitan ketika memainkan game ini?</i> | Yes/No |
| 2 | Error Navigation | <i>Apakah kamu menemukan tombol yang bekerja pada game ini?</i> | Yes/No |
| 3 | Language Error | <i>Apakah kamu menemukan sedikit kesalahan bahasa atau tata bahasa pada game ini?</i> | Yes/No |
| 4 | Clear Screen Design | <i>Apakah desain pada game ini mempunyai warna dan tampilan yang jelas?</i> | Yes/No |
| 5 | Level or challenge | <i>Apakah di setiap level/world pada game ini, kamu menemukan urutan atau tingkat kesulitan yang berbeda-beda?</i> | Yes/No |
| 6 | Contain mirror reflection concept | <i>Apakah kamu menemukan materi tentang sifat pembentukan bayangan pada cermin datar, cekung, dan cembung pada game ini?</i> | Yes/No |
| 7 | Perception of Mirror Reflection | <i>Apakah game ini membantu kamu memahami materi pembentukan bayangan pada cermin datar, cekung, dan cembung?</i> | Yes/No |
| 8 | Clear goals | <i>Apakah game ini memberikan tujuan yang jelas terhadap apa yang harus kamu lakukan untuk menyelesaikan misi?</i> | Yes/No |

(Adapted by Gambari & Yusuf, 2014; Kumar, Herger, & Dam, 2018; Zichermann & Cunningham, 2011; Cheong, Filippou, & Cheong, 2014)

The second questionnaire is to assess how much they see these aspects of gamification being used in the game. It has three aspects with three statements; the survey was asking

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students agreement from 1 – 5 by using a Likert scale. Which the questions and aspect are mentioned as follow:

Table 3. 3
Gamification Aspects

| Aspect | Statement |
|-------------------------|--|
| Challenging environment | <i>Saya mendapatkan tantangan pada game ini</i> |
| Goal | <i>Tujuan dan misi pada setiap world/level jelas</i> |
| Content Perception | <i>Penjelasan materi fisika, cahaya dan sifat pembentukan bayangan pada cermin datar, cekung, dan cembung pada game ini mudah dipahami</i> |

The third questionnaire is to assess or see how gamification aspect affects motivation, joy, convenience, addiction, physics perception, attractiveness, and interactiveness which has one question in each of it. The aspects were adapted from several research which is (Hamari, Koivisto, & Sarsa, 2014), (Zichermann & Cunningham, 2011), and (Shapiro, SalenTekinbaş, Schwartz, & Darvasi, 2015). The scale used was Level on Agreement in Likert Scale from 1 - 5. Which the questions and aspect are mentioned as follow:

Table 3. 4
Gamification Effect to Motivation & Behavior

| Aspect | Questions |
|-------------|--|
| Motivation | <i>Saya semakin bersemangat untuk belajar fisika setelah bermain Starship war game</i> |
| Joyness | <i>Permainan ini tidak membuat saya bosan</i> |
| Convenience | <i>Game ini mudah untuk dimainkan</i> |
| Addiction | <i>Saya ingin bermain game Starwarship kembali</i> |

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| Aspect | Questions |
|--------------------|---|
| Content Perception | <i>Memainkan game ini membuat saya meningkatkan pemahaman sifat pembentukan bayangan pada cermin datar, cekung, dan cembung</i> |
| Attractiveness | <i>Game ini sangat menarik untuk dimainkan</i> |
| Interactiveness | <i>Game ini interaktif untuk dimainkan</i> |

(Adapted by Hamari, Koivisto, & Sarsa, 2014; Zichermann & Cunningham, 2011; and Shapiro, SalenTekinbaş, Schwartz, & Darvasi, 2015)

For both scales by students questionnaire, the data was judge by using a Likert scale for Student' Level of Agreements, and it shows below:

Table 3. 5
Likert Scale for Students' Level of Agreement

| Scale Criterion | Point |
|---------------------------|-------|
| Strongly Disagree | 1 |
| Disagree | 2 |
| Neither agree or disagree | 3 |
| Agree | 4 |
| Strongly Agree | 5 |

The data were collected for each of the aspects of the point that is given by the students and counted for each scale criterion for how many students agree with each scale by using simple addition. After that, The experts' judgment rubric was analyzed by a quantitative measurement, adapted from (Riduwan & Akdon, 2010). Then, comparing the result with the total amount of highest score and the result is converted to a percentage where Na is total of score given from all the students, Nx is the total number sample which is some students.

$$\% = \left(\frac{Na}{Nx} \right) \times 100\%$$

(Riduwan & Akdon, 2010)

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3.5.3 Written Review

The rubric and questionnaire for experts' judgment have each additional space to give an opinion, remarks, and comments about each aspect. The questionnaire for students has one space to give an opinion, remarks, and comments.

3.6 Research Procedure

In order to make the systematics research, research procedures divided into three stages which are preparation, implementation, and completion. The research plot can be seen in Figure 3.1. Flowchart stages. The steps in preparation stages are 1) Literature Review of Computer-assisted instruction while doing Literature Review of gamification and mirror reflection topics, 2) Identification of problem, 3) Creating game, 4) Creating rubrics and questionnaire while creating video explanation, 5) Science expert, media expert, teacher, and students try the game, 6) Data Collection, 7) Data Analysis, 8) Making result, conclusion, and discussion and the last is 8) Reporting the result. The flowchart stages can be seen in Figure 3.1 Flowchart stages below.

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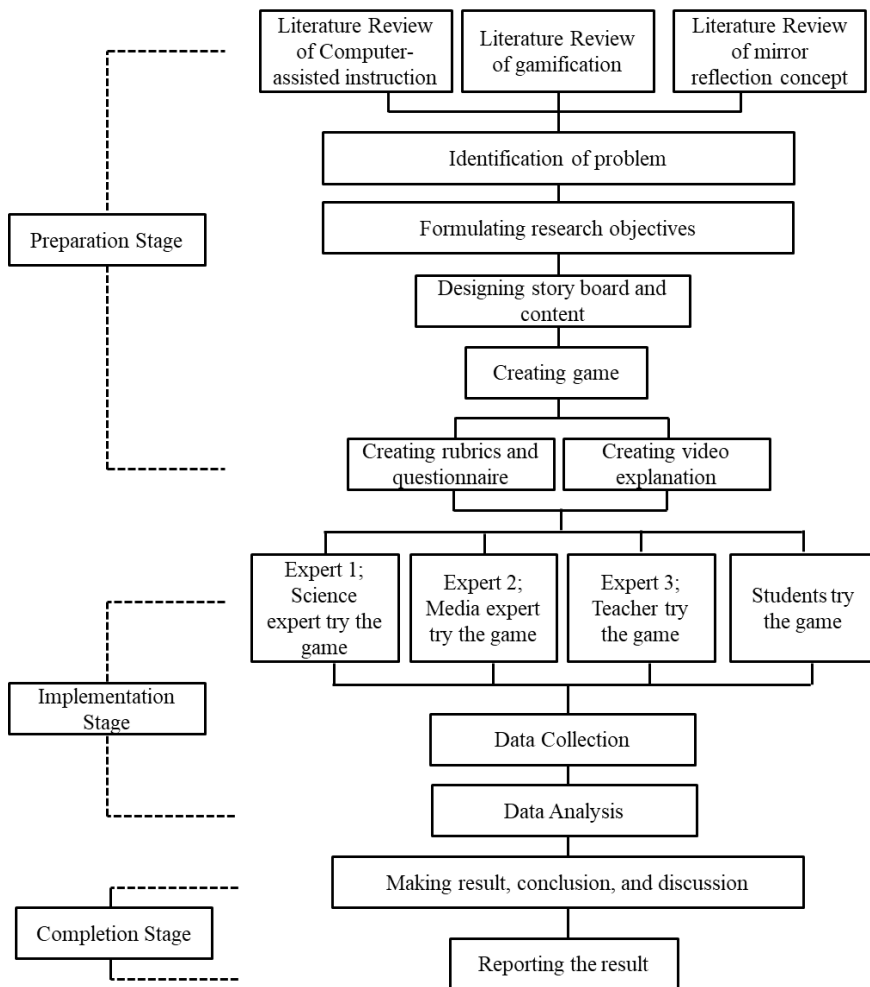


Figure 3. 1 Flowchart stages

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