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VISUALIZING THE STAGES OF THE EDUCATIONAL RESEARCH METHODOLOGY INTO ANIMATION INFOGRAPHICS FOR VOCATIONAL STUDENTS

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Abstract

Visualizing something abstract into a concrete object can help students improve their mastery of concepts in learning. The purpose of this study is to visualize the stages of the educational research methodology into an animation infographic media. The method used refers to the instructional development model. The target subjects of this study were students of informatics engineering education study program who had taken courses in educational research methodology. In order to get valid, practical, and effective media, several tests were carried out, such as formative evaluation and effectiveness testing with Hake formula. The results show that the dynamic infographic media produced has gone through expert judgment as follows. (1) Testing by content experts score 1 (very high), testing by the learning design experts scored 0.92 (very high), and testing by learning media experts scored 0.90 (very high). (2) The result obtained from the practicality testing is 86.5%, or it is included in the practical category. (3) The testing of the effectiveness of using the Hake formula obtained N-gain results of 0.8, which belongs to the effective category. It shows that animation infographic media produced is valid, practical, and effective to be used in improving the concept mastery of the stages of educational research methodology in informatics engineering education study program.

Keywords: *visualizing, animation infographics, stages of educational research methodology, vocational education*

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INTRODUCTION

Learning is the process of acquiring knowledge. This process makes people who previously do not know about something to become aware of it. How to obtain knowledge varies. Humans use different styles depending on learning styles that are considered easy to understand. Some styles chosen by a person are called learning modalities. There are two categories related to "how learners learn", namely, how learners can absorb information easily (modality) and how students manage and process that information (brain dominance). Therefore, learning styles are a combination of these two categories, namely how students absorb, organize, and process information. According to de Porter and Hernacki, learning styles, based on one's modality, are divided into three groups, namely, visual modalities (learning by seeing), auditory modalities (learning by listening), and kinesthetic (learning by moving and touching). Furthermore, it is also explained that one of the most effective learning styles in the world of education is visual modality (Suhara, 2013).

Several results of the research state that the three learning styles are effective in improving students' abilities, both visual, auditory, and kinesthetic. Based on the results of hypothesis testing, it shows that t count > t table, i.e., 9.83> 2.00 on the degree of freedom n - 1 = 48 with a confident level of 95%. Thus, the three learning styles are effective in improving students' abilities (Suhara, 2013). In addition, among the three learning styles, the visual learning style turned out to be more dominant than auditory or kinesthetic. There are 50.94% of students more likely to have a visual learning style. This result was obtained through a survey of students using a questionnaire that had been adapted from de Porter (Siwi, 2016).

Visual modality is a learning style in which ideas, concepts, data, and other information are packaged in the form of images and techniques. Students who have visual modalities have a high interest when they are shown images, graphics, organizational graphics such as nets, concept maps, and map ideas, plots, and other visual illustrations. Some techniques used in visual modalities are to improve thinking and learning skills, and prioritizing vision (visual). In the visual modality, many models and learning methods are needed that are used with the emphasis on modeling. Learning media are objects related to the lesson, or by showing the tools directly to students or also describing them in front of the board (Rusman, 2012). The body language and facial expressions of the instructor are also very important to convey the subject matter. They tend to sit in the front so they can see the subject-matter shown clearly. They think of using images in the brain and learning faster by using visual displays, such as diagrams, illustrated textbooks, interactive CDs, digital content and videos, and also information which is packaged in graphical forms. In the classroom, visual children prefer to read and record up to the details to get information.

The requirement to master the learning style of visual modalities is that students must love reading. Reading is the main thing that must be carried out by a student because reading can make students more independent in acquiring knowledge. Nevertheless, in reality, it is very rare for students to have an interest in reading. It can be seen from the Indonesian reading index which is issued by the Central Bureau of Statistics (2012), which explains that 96.68% of the population is 10-year old kids who over prefer watching television, and only 17.66% are reading. This problem becomes more serious when students want to learn something complex, and there are courses which have very solid, descriptive and varied material such as educational research methodology courses.

On the other hand, mastery of graduate concepts and competencies can be improved through quality learning services by utilizing Information and Communication Technology (ICT) (Tandirerung & Hadi, 2014; Zyainuri & Marpanaji, 2013). It becomes one of the most important parts in supporting the learning process. The use of ICT in the world of education has changed the pattern and interaction of learning (Hanum, 2013; Sindu & Paramartha, 2018). Many educational technology experts have developed various learning-support media. They work with information and communication technology experts. Products produced such as Augmented Reality (AR), Video Blog (Vlog), Interactive Whiteboard, and media infographics. Learning must provide opportunities for students to actively try to construct their own knowledge and competencies

that must be possessed. It becomes a demand and even a serious concern of the learning designers. The role that must be performed by students is as a publisher, audience, and peer reviewer of knowledge. The role of the lecturer is only as a facilitator and stimulator of student activities for learning. Therefore, students must be facilitated to carry out the learning process in order to construct their own knowledge and master the competencies that must be mastered (Ackermann, 2012; Agustini et al., 2017; Gredler, 2009).

On the other hand, mastering the concepts and competencies of graduates can be improved through quality learning services according to the types of research they choose. Based on interviews with one of the educational research methodology subject lecturers at Universitas Pendidikan Ganesha, there were three problems in learning, namely, (1) some students are confused in distinguishing research topics. They have not been able to distinguish between experimental topics, technology and vocation education, educational engineering, and informatics engineering. In fact, distinguishing research topics can be done by differentiating the research methodology. (2) There is a tendency for students to be lazy and do not want to find their own references, so they do not understand the procedures in each of the existing research methods. It can be seen from the many questions about research methods that are repeatedly asked by different students when conducting research guidance. The student's laziness is the impact of low student interest in reading. (3) The absence of media that comprehensively discusses each research procedure in one unit of educational research methodology.

The impacts of these problems are that (1) it takes time to determine the type of research due to the confusion, and (2) the research stages used by students are mostly untrue, which results in high costs in the thesis-making process. Both of them lead to the obstruction of the students' thesis preparation process.

Based on these problems, it is crucial and urgent to develop media. A solution is needed to attract students' interest so that they can understand the existing research methods and procedures correctly. The solution that can be done is to develop visual media in the form of infographic animation. This media can convey reliable information to become simpler but does not eliminate the true meaning. Many types of visualization can be used to represent the same data set. Therefore, it is essential to identify the appropriate visualization for the data set by considering graphics features such as position, size, shape, and color.

There are five types of visualization categories, namely time-series, statistics, maps, hierarchies, and networking. Time-series visualization emphasizes a form of a timeline that can be used as a timepiece by documenting a set of values over time. Time-series visualization shows interactive graphs that present things that change over time. The form of infographics which is visualized in time-series can be used in showing a development clearly and is easily remembered. Statistical visualization emphasizes the disclosure of trends based on how numbers are distributed. Examples that are oftenly used are histograms and box-and-whisker plots. Statistical visualization conveys statistical features such as average, median, an outlier. Visualization maps emphasize the representation of geographical data. Time and space can be described through the use of flow maps. Visualization maps can use lines of various sizes, including width and color, to help encoding information. Visualization hierarchies emphasize hierarchical data sets that have a large number of members. Visualization hierarchies can be realized using node-link diagrams, adjacency diagrams, and enclosure diagrams. Visualization hierarchies can have an impact on infographic visualization that is effective in communicating hierarchical data. Visualization of networking emphasizes visualization that explores relationships between nodes. The node representation can be various. Nodes can be represented as problems, activities, solutions, and so on. Three common types of visualization of networking include force-directed layouts, arc diagrams, and also matrix views. Nowadays, visualizing networking can describe a difficult concept easily with just one form of an infographics. In addition to the visualization category, there are also two types of graphics used in forming infographics, namely theme graphics and reference graphics (Ru & Ming, 2014).

Furthermore, according to Ru and Ming (2014), there are three important steps that have been proven effective in applying infographics in a learning medium. The first step is

knowledge-conversion. Knowledge has powerful characters, and infographics can be used to show the strength of that knowledge. As a characteristic of infographics, knowledge must first be changed from the abstract form into something that can be seen in plain view by determining which categories to use in making infographics. Then, carrying out activities by marking important content that will be used in the infographics is needed. Next, choose the right color and image. This selection is very important to do in the first stage. The final step in this first step is to try to combine these things and make an infographic that might look simple or even complicated. However, good infographics are not seen from simple or complex forms of visualization. Rather, a good infographic is infographics that are easy to understand and not confusing.

The second step is reviewing the infographics. This step is a detailed step in the infographics that was generated in the first step. What that needs to be done is to determine the type of infographic, whether it includes the type of the graphics theme or reference graphics. Types of graphics themes usually visualize a model or have certain characteristics. Usually, each infographic has this type except statistical infographics. Choosing a theme which matches the infographic design is important. When infographics contain a theme, students can immediately guess what knowledge they will receive without needing to tell them. This type of reference graphics is very rarely found in an infographic and is something that is not mandatory. The types of infographics that contain reference graphics usually contain icons that are used as visual markers in their infographics. It is applied in infographics that have very much content in it. In order to avoid the formation of a messy design, this type of infographic is considered necessary to use icons to be able to represent these contents. Sometimes, words are not even needed if we can choose the type of strong icons. Doing this step as often as possible can increase the speed and accuracy in choosing the type of infographic that matches the characteristics of the knowledge we want to explain.

The third step is to tell the story. This step is the final step, where infographics are clearly formed. These infographics can be directly given to students while telling things related to that knowledge. Here, the teacher can become the person who guides students to see infographics so that the infographic viewpoint can be seen from the same point. Infographics is considered to represent tens of thousands of words. Therefore, it can be both a strength and a weakness. The disadvantage is when students see from a different perspective so that it will have an impact on different thinking and understanding. It is where the teacher's guidance is emphasized. Students must get the right guidance and find the knowledge behind the infographic.

Until now, the implementation of infographics can be differentiated from two applicable forms (Hassan, 2016). The first is static infographics, and the second is animated infographics, or it can also be called motion infographics. Static infographics or static infographics are infographics which are designed to be printed like posters and diagrams that are usually found in articles, magazines or newspapers, and advertisements. The use of static infographics in digital media can be found on websites and Videotron without entering any movement, or there are no animated elements or features.

In contrast, animated infographics, or we can also name it motion infographics, are infographics which are designed with the intention of screenplaying-view and are displayed on the screen. Examples of motion graphics videos are the videos on websites such as YouTube and Vimeo, TV ads, museum exhibitions, and also kiosks. Animated infographics have elements that usually move constantly and have data which are displayed in the form of animation. Movement or motion is usually made on a computer using animation software. Both static and animated infographics prove effective in increasing knowledge and understanding. Possible reasons for this effectiveness are that the visual and graphic explanations which are seen by learners are really interesting, creating visual interest, and providing interesting data about learning material. It reinforces the results of the theory of Multiple Intelligence and Neil Fleming's VAK model, in which it is found that humans can learn and understand information through three types of stimuli, namely Visual, Auditory, and Kinesthetic (VAK) stimuli. The infographics which are used in this study are animated infographics which can offer these stimuli with more emphasis on visual stimuli.

Research related to animated infographics is used as a reference in developing animated infographic media. It is research conducted by Bellei et al. (2016), which results in a cost-effective approach in developing animated infographic media. The approach taken is a pedagogical approach that refers to educational outcomes. The use of animation for education has been widely published; several studies describe in-house collaboration by developing the use of resources from instructors and students. In the results of their research, they presented a unique, innovative, and also cost-effective method for producing animated infographic media. The realization of the approach refers to collaborative activities between teachers and students. According to them, the collaborative development process offered can provide results in the form of original, high-quality, and effective additional teaching products that are widely reviewed and pedagogically interesting for all students involved.

Research by Mulyate et al. (2013) also develops infographic products in the form of infographic books "Recipes of various appetizers and conclusions for Western devices for children". The product testing results are in the positive domain. Children can accept infographics. They feel helped by the information presented, especially in getting more specific types of food that are liked by children.

Another research conducted by Susetyo et al. (2015) measures the effectiveness of infographics as supporting Social Sciences subjects in 5th-grade students. The results obtained the increased absorption of students to the lessons conveyed and the hange in value to be better than the previous generation. In addition, the use of infographics proved effective with the results displayed from the hypothesis test.

RESEARCH METHOD

The method which is used in the development of infographic media is Research and Development (R & D) Method. The stages referred to are the Instructional Development Model (*Model Pengembangan Instruksional* or MPI), according to Suparman (2012), who adapted Dick and Carey (2005). The steps taken were identifying the media infographic needs, designing media and storyboards, implementing design and storyboarding, evaluating formative stages through limited trials including expert judges, effectiveness tests and practicality tests, and finally analyzing user responses.

Formative evaluation is carried out through several stages of testing, such as one-to-one testing of experts (content experts, learning design experts, and learning media experts). In addition, the one-to-one learner is also conducted, namely students. Small group tests were carried out for eight to 20 students. Large group tests were carried out to 15 to 30 students. The question is limited to classes that are similar to the actual class (Suparman, 2012).

In order to determine the effectiveness of the product, an evaluation was carried out using the design of the pretest-posttest control group design to a group of students who had taken the Education Research Methodology (ERM) course. The types of data, data sources, methods, instruments, and evaluation times can are presented in Table 1.

Table 1. Map of Method

Type of Data	Data Source	Method	Instrument	Time
Formative Evaluation Data	Judges/expert	*One-to-one judges/expert evaluation*	Content questionnaire & language, design questionnaire, media questionnaire	After the development stage, the draft is complete
	Student (3 student)	*One-to-one leaner evaluation* with interview	Interview questionnaire	After *expert evaluation* revision was completed
	Students who have taken ERM (8 until 20 students)	Small group evaluation	Small group questionaire	After a one-to-one learner evaluation was revised
	Student who have taken ERM (15 until 30 students)	Field trial	Field trial questionaire;	After the group evaluation was revised

Source: MPI model (Suparman, 2012)

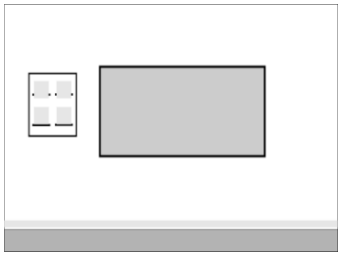
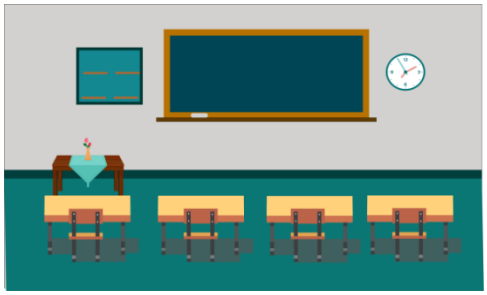
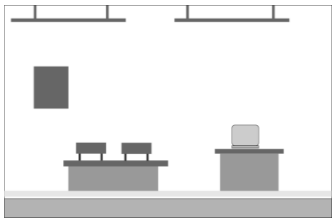
RESULTS AND DISCUSSION

The identification result of media and infographics requirement comes from the interviews and observations of students in a classroom. The result shows that (1) students require a lot of time in doing a research because they still have confusion to differentiate the research topics, (2) the Educational Research and Methodology course has a solid and descriptive material that tends to make the student lazy to search many resources about research methodology, (3) there are no instructional media that comprehensively discuss about each research procedure in a unit of education research methodology. Due to those problems, there are some media that need to be developed. The developed media include (1) infographic-based media material for MPP course, (2) 2D-animated video, (3) media that can deliver the methodology procedure material in a simple way, (4) for students, this media can help them to understand about research methodology procedure, while for lecturers, this media can help them in their lecturing process, (5) the media in the form of video can be shown in e-learning which owned by education research methodology lecturer, (6) the media can be shared to everyone that want to learn more about education research methodology.

Table 2. Design Result and Character Implementation in Media

No	Character	Design Images	Interface Implementation in Media
1	Profesor 2D		
2	Teacher 2D		
3	Judges 2D		
4	Principal 2D		
5	Female student 2D		
6	Male student 1 2D		
7	Male student 2 2D		

Table 3. Design Result and Supporting Image Implementation

No	Image Name	Design Images	Interface Implementation of Images
1	Class room		
2	Test room		

The media's and storyboard's design and implementation result consist of the main characters, nature of the characters, and the problems. The video consists of four synopses, including (1) stage of research experiment synopsis, (2) stage of technology and vocation education synopsis, (3) stage of informatics engineering research synopsis, and (4) stage of educational engineering research synopsis. The character that is successfully created can be seen in Table 2. Table 2 illustrates the characters, design drawings, and implementation image. There are seven characters in this infographic video, which are, (1) professor, (2) teacher, (3) examiner, (4) headmaster, (5) female students, and (6) male students.

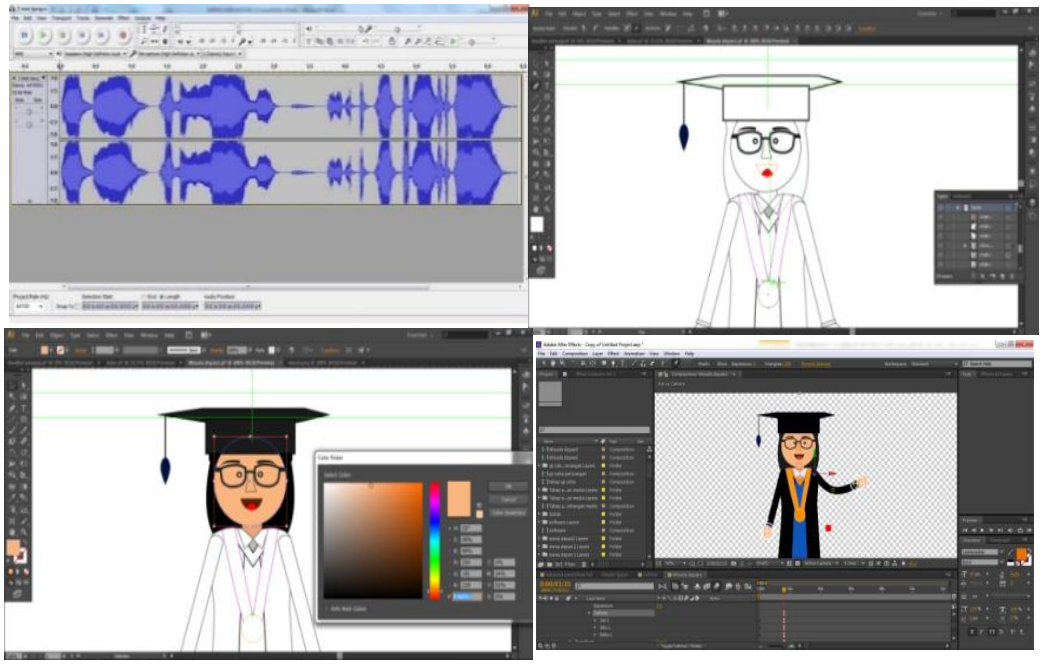
Then, supporting images are also produced in the form of two dimensions, as shown in Table 3. Table 3 contains supporting images such as classrooms and also testing rooms.

The creating process is through development stages, such as audio recording stage, modeling stage, texturing stage, rigging stage, animation stage, rendering stage, and video editing stage. Figure 1(a) and (b) are the result of each stage. It shows that all of the characters of the developed design in every stage is in accordance with the characteristic of the learning process in details. Characterizations were created to make this infographics animation media more unique.

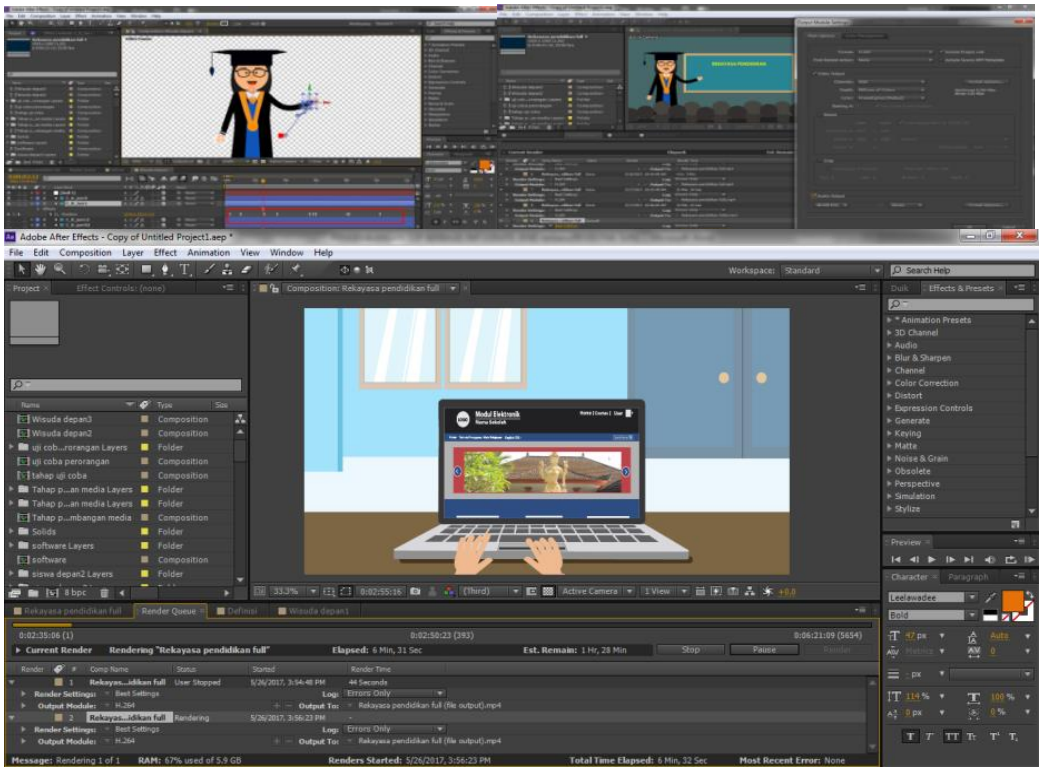
The results of the formative evaluation stage in the expert judgment section (validity test) consist of the results of the tests on content experts, learning design experts, and learning media experts. Each expert test was conducted on two content experts, learning design, and media using the Gregory formula. The test for content experts obtains a score of 1 (very high), while the test of the learning design experts is 0.92 (very high), and the test for learning media experts is 0.90 (very high).

The practicality test results were carried out on 36 students. They are divided into four groups of respondents, with each group consisting of nine randomly-selected students. The practicality test results from user response analysis found a percentage of 86.5% converted into the conversion table stated as "practical".

Moreover, pre-test and post-test were conducted on 20 of the same users when testing user responses. The pre-test and post-test questions used were 20 multiple-choice questions. There are four stages in Animation Infographics in the whole questions: the stages of experimental research, technology and vocation education, informatics engineering research, and educational engineering research. The subject of the experimental research, technology and vocation education, in-formatics engineering research, and educational engineering contained five questions for each.



(a)



(b)

Figure 1.(a) & (b). Results at the Stage of Development of Animation Infographic Media

During the pre-test, the total value of the experimental research stage seen from the user's answer is 70, the score of the technology and vocation education stage is 41, the score of the informatics engineering is 35, and educational engineering is 40. It means that the stage of experimental research's score is 84, the stage of technology and vocation education is 54, the stage of informatics engineering research is 39, and the stage of educational engineering research is 60. Its representation can be seen in Figure 2.

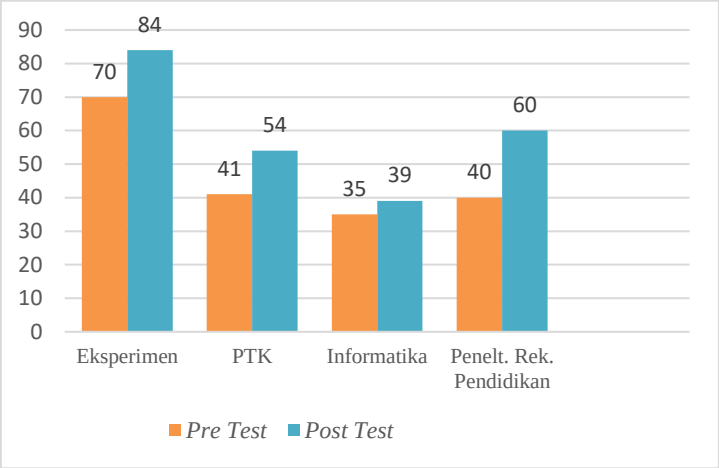


Figure 2. Pretest and Posttest Comparison Value

From the results of the pre-test and post-test analysis, the average percentage increase in the value of 31.62% from the original is 58.5 to 77. The next step is to find the value of N-Gain or Normalized Gain to determine the level of increase in the post-test results. The formula for calculating N-Gain using the formula of the difference between the value of the post-test and the pre-test is divided by the difference in the maximum value with the value of the post-test. After the calculation is obtained, the N-Gain value is 0.8, so that the rate of increase in the results of the post-test goes to the high criteria referring to the four criteria table of normalized gain by Hake (1999), as shown in Table 4. Based on these results, the media infographic animation stages of the study are able to improve the understanding and knowledge of users; in this case, the students of informatics engineering education programs.

Table 4. Interpretation on the Value of g

Range of g Value	Description
$0.7 < g \leq 1$	effective
$0.3 < g \leq 0.7$	Effective enough
$0.0 < g \leq 0.3$	Less effective

Source: Hake (1999)

Infographics, as a messenger media, can be an alternative solution that can be used to improve students' understanding of mastering complex material concepts more easily and quickly. Arigia et al. (2016) in Lankow's book entitled "*Kedasyatan cara bercerita visual*", said that the advantages of visual communication through infographics are that image visualization is able to replace explanations that are too long, and replace complex and full numbers tables (Lankow et al., 2014). With the visualization of the stages of educational research methodology, that pre-viously looks complex and a little confusing, it turns out to be easier and clearer to be done step by step in each type of research.

It is also in line with some previous studies, such as Arigia et al. (2016), Miftah et al. (2016) Susetyo et al. (2015), and Taufik (2012), which mention that the humans' eyes are faster at capturing information presented in visual (graphic) than in textual form, then they tend to put greater attention to reading the contents of the message delivered.

CONCLUSION

It is concluded that the animated media infographics have gone through the stages of instructional development models that refer to Dick and Carey. The results of the formative evaluation, which experts have carried out are as follows. Testing by the content expert obtains a score of 1 (very high), testing by the learning design expert obtains a score of 0.92 (very high), and testing by the learning media expert obtains a score of 0.90 (very high). Then, the result of practicality testing is 86.5%, which is categorized in the practical category, and the result of the effectiveness testing using the Hake formula is the N-gain of 0.8, which is in the effective category. It shows that the Animated Infographic media produced is valid, practical, and effective to improve the mastery of the concept of the educational research methodology course in informatics engineer-

ing education. In order to find out the effect of the product on learning outcomes, it is advised to conduct experimental research or classroom action research so it can move from becoming confusing to be clearer to step up on the stages in each type of research.

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