Chapter 18

Visual Programming-Based Visual Learning Media to Learn Programming Technique With Fuzzy Rating

I. G. P. Asto Buditjahjanto
Universitas Negeri Surabaya, Indonesia

M. Riduwan
Universitas Negeri Surabaya, Indonesia

ABSTRACT

Programming techniques is a difficult subject for the majority of students at vocational high schools in Indonesia. One of the problems is that the teaching-learning process still uses textual learning media with no interaction with students. Visual learning media offers some advantages to attract the attention of users, interact with users, involve users, and multimodal for users. Because of this, it is necessary to develop visual learning media to utilize visual programming to make it easier for students to understand programming techniques. The aims of this chapter are to determine the learning media feasibility utilizing visual programming to find the students' responses to utilizing visual learning media and to applying fuzzy rating for the feasibility and students' responses toward media learning based on visual programming. The research results showed that fuzzy preference can be applied to assess the learning media feasibility and students' responses to the use of visual learning media utilizing visual programming.

INTRODUCTION

The industrial revolution 4.0 that we are facing nowadays has an impact on the use of computers. As a result, the use of computers has become part of daily needs. Almost all human activities are related to computers. This can be seen from the progress of computers utilization in the sectors such as smart manufacturing sector, the internet of things (IoT) sector, industrial internet sector, and cloud-based manufacturing sector (Vaidya et al., 2018). Computer appearances have some types such as PCs, mobile

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phones, tablets, laptops, iPads, etc. The varieties of computer devices make them easier for people to access data or information. This data or information, in the education area, is manifested in the form of learning material. The ease of delivering this learning material makes it easy to be accessed by students both during learning in the classroom and outside the classroom. Several studies have examined the use of these computer devices for learning. Utilizing mobile phones can assist the students to improve understanding and mastering in the course of speech signal processing learning material (Zhao et al., 2017). According to Pruet et al. (2014), using laptops and tablets makes it easy to access low-cost learning technology, to identify students' learning styles, and to find out students' attitudes towards tablet computers utilize and how these are related to their academic performance. The use of computers in education has also been growing rapidly. They can be manifested in the form of computer applications. These computer applications can be applied to support in the learning process of the students to comprehend a subject. Some researchers have used a computer application to assist the students in order to make easier to learning a subject. The subjects that has been investigated by some researchers are as follow: science (Barak et al., 2011; Rutten et al., 2012), robotic (Major, 2014), speech signal processing (Zhao et al., 2017), and computers programming (Kazimoglu et al., 2012; Claypool, 2013; Ouahbia et al., 2015).

In the learning process, it needs a learning material to teach in the class. Good learning material is able to attract students' attention and also able to motivate students to learn that learning material (Claypool, 2013). How to make a learning material is interesting for the students? One of the ways is by accompanied by a learning media. Learning media that are manifested in visual form will be more interesting when it compared to a learning media with just texts only or non-visual. Learning media using visuals can involve student motivation and interaction in learning. The computer application can be used as visual learning media. The manifestations of visual learning media based on the computer can be represented such as simulations, animations, and games. Each of these computer applications has the advantages to be applied to learning material. According to Barak et al. (2011), animation as learning media that implement to study the field of science can improve learning outcomes and motivate students. That matter is supported by Lin & Robert, (2011) which states that animation can assist learners' gain and retention of concepts and processes scientific. According to Major (2014), learning media in the form of computer simulation make it easier for students to understand the material of computer programming and also increase students' motivation to learn. According to Rutten et al (2012), learning using media computer simulation can improve learning processes and outcomes from students. Computer games that are used as learning media also own the capability to support students in the learning process. Computer games can be used as solutions to overcome the difficulties of learning in computer programming and increase students' motivation in the use of serious games in the learning process (Ouahbia et al., 2015). Computer games can also be used to develop capabilities in computer programming (Kazimoglu et al., 2012). Each learning media with this computer application has excellence specifications tailored to the material delivered to students.

Learning computer programming using conventional methods, there are still discovered that many learners perceive difficult to understand that subject. Learning to computer programming is recognized as being problematic for students (Thota & Richard, 2010). According to Ouahbia et al. (2015) stated that a number of researchers have put on record some difficulties encountered by students that learn concepts of basic programming. One of the records is computer programming learning that is considered a difficult subject and also the lack of learning media used by to assist in explaining the learning material. The existing media is still conventional consequently the students feel to be inconvenient to learn a subject if the media learning only based on textual learning. Therefore, it is needed learning media that can help to facilitate in learning computer programming (Bati et al., 2014). According to Zyl et al. (2016), computer programming is a difficult lesson. Therefore, it is needed a visual learning media that can help teachers to teach programming concepts easily.

Vocational High School in Indonesia also teaches computer programming as one of the subjects with competency skills of audio-video engineering. The name of the subject is programming techniques. When learning this subject, mostly the students faced the same problems. They perceived that the subject was a difficult subject and the learning process still used text-based learning media. Therefore, the objectives of this study are:

- To determine the learning media feasibility utilizes visual programming in the subject of programming techniques.
- To find out the students' response who utilizes the visual programming-based visual learning media in the subject of programming techniques.
- To apply fuzzy rating for feasibility and students' responses toward media learning based on visual programming

LITERATURE REVIEW

Visual Programming Application as Learning Media

Computer-based learning media as one of the developments of computers can help students to learn a learning material. Computer-based learning media has many advantages. Ardaiz-Villanueva et al., (2011) state that computer-based learning media such as creativity connector tools and wikideas are the instruments that supported students to generate, select, and evaluate teams for project execution. According to Gan (2015), the use of computer-based learning media for learning can assist to mastery of digital interactive media with the result that, students in groups able to work together to maximize their own and each other's learning.

A quote from Confucius, a Chinese philosopher, who stated "I hear and I forget. I see and I remember. I do and I understand." Therefore, learning is not enough just to listen to the teacher explain the learning material but also required a learning media to visualize the learning material and able to interact with the students so that it can improve the understanding and mastery of learning material by students. Learning by using visual learning media has many aspects that are beneficial in learning. According to Vimonsatit and Trevor (2016), learning using visualization in the civil field can increase students' understanding of the Building Information Modelling material provided. Research conducted by Temel and Fatih (2017) also shows that visual learning can improve students' drawing skills better than learning that does not use visual media. In the field of electronics, the use of visual learning media can help students understand the workings of an electrical circuit. Poole (2007) applies visual basic to simulate the calculation of an electrical circuit. This simulation makes it easy for students to understand the analysis of an electrical circuit in which the resulting simulation provides feedback provided to students.

Visual learning media can be applied to assist students to learn computer programming which this subject is perceived troublesome by students. Visual learning media which has interactive elements can attract students' attention to understanding difficult material. That matter is supported by several studies that have been conducted. Sáez et al (2016) conducted a study toward elementary students in five different schools using the visual programming language (Scratch). The results of the study showed that the learning outcomes and attitudes of the students increase significantly. To attract students' attention then the visualization of the visual learning media must be dynamic. Kühl et al., 2011 investigated the effect of text modality on learning process by used static and dynamic visualizations. The results of the research showed that learning outcomes using learning media with the type of visualization dynamic provided better learning outcomes than with static learning media. According to Eric et al., (2012), computer programming is a detailed understanding of dynamic processes. Consequently, visual learning media with only static text and images are not enough suitable for explaining learning material of computer programming. Therefore, visualization of dynamic in computer programming is needed to overcome these problems. Students' engagement or student interaction with learning media is another factor that also influences the learning outcome of students. It is important as ways of engaging students in activities (Moons & Carlos, 2013 and Graham et al, 2007). According to Chijioke et al. (2016) that direct involvement is needed in learning computer programming. Therefore, involvement of students directly in a visual programming learning activity is important. By involving students in activities, it can improve student learning outcomes.

A good visual learning media for learning computer programming does not only have graphical items but also has computational problem items. The computational problem items can be helpful for students in supporting programming learning. Tan (2014) used a virtual laboratory for learning C programming. This laboratory simulates the fundamental management of laboratory animals. So, students can learn the need and how to arrange a laboratory for an animal with a real case. In the simulation, students can learn a series of quantities of animals that their attributes represent in vector, digital, graphical, or bar. According to Juha et al., (2013), the use of visualization in computer learning aims to investigate the behaviour of existing programs. Whereas according to Chao (2016), a visual programming environment can support students to learn computer programming better. It can be happened, because the students can learn how to solve computational problems by analyzing, designing, implementing, and evaluating. Learning media based on visual programming is an instrument that visually can demonstrate concepts and ideas which can support in the teaching of programming computer (Graham et al, 2007).

Rating Scale

A rating scale is a set of categories that designed to obtain information or evidence about some attributes both qualitatively and quantitatively (Novák, 2015). Rating scales have been widely used to evaluate the attributes of individuals, animals, places, things, or abstract ideas, various product or service evaluation questionnaires. Rating scales, such as, Likert scales, Guttman scales, describe simple instruments that have been used for rating attitudes, judgments and subjective preferences in human rating contexts (Calcagnì & Lombardi, 2014). Rating quality has become easy to use because of its convenience. Rating is easy to explain and can be directly analyzed through statistical methods. When rating an object, it is needed to establish a preference. An expert or a user usually gives a preference. The preference ratings could differ from one expert's rating to another, because of the subjective nature of the evaluation process (Tang et al., 2015).

Nevertheless, standard rating scales also have weakness from certain relevant limitations. For example, standard rating scales fail in measuring fuzzy and uncertain information. This is caused by the standard rating scales are only able to obtain the last outcome of the respondents' response. As it is known, the conventional rating has weaknesses in measure things that are vague or imprecise information (Wang & Chin, 2011, 2011).

To cope with these limitations, Fuzzy Rating Scale (FRS) has been recommended over the years. FRS has many advantages in translating linguistic rating especially for measuring things that are vague or imprecise information compare with the conventional rating (Calcagnì & Lombardi, 2014). According to Sara et al., (2015) the FRS is a tool to capture and accurately reflect diversity, subjectivity, and imprecision inherent to human perceptions to some questionnaires. Another convenience in using FRS is a graphical tool which allows collecting human rating data entirely (Calcagnì & Lombardi, 2014). Lubiano et al., (2016) states that the freedom inherent in FRS processes allows users to gather information with expressiveness, accuracy, diversity, and subjectivity. The FRS is especially valuable for statistical purposes. Based on these advantages, according to (Liu et al., 2015), the use of FRS for rating has been widely used in various fields. There are such as finance (Yue et al., 2007), Petrochemical Industry (Rahdari, 2016), shipping (Xin et al., 2015) education (Guajardo et al., 2015).

Fuzzy Inference System

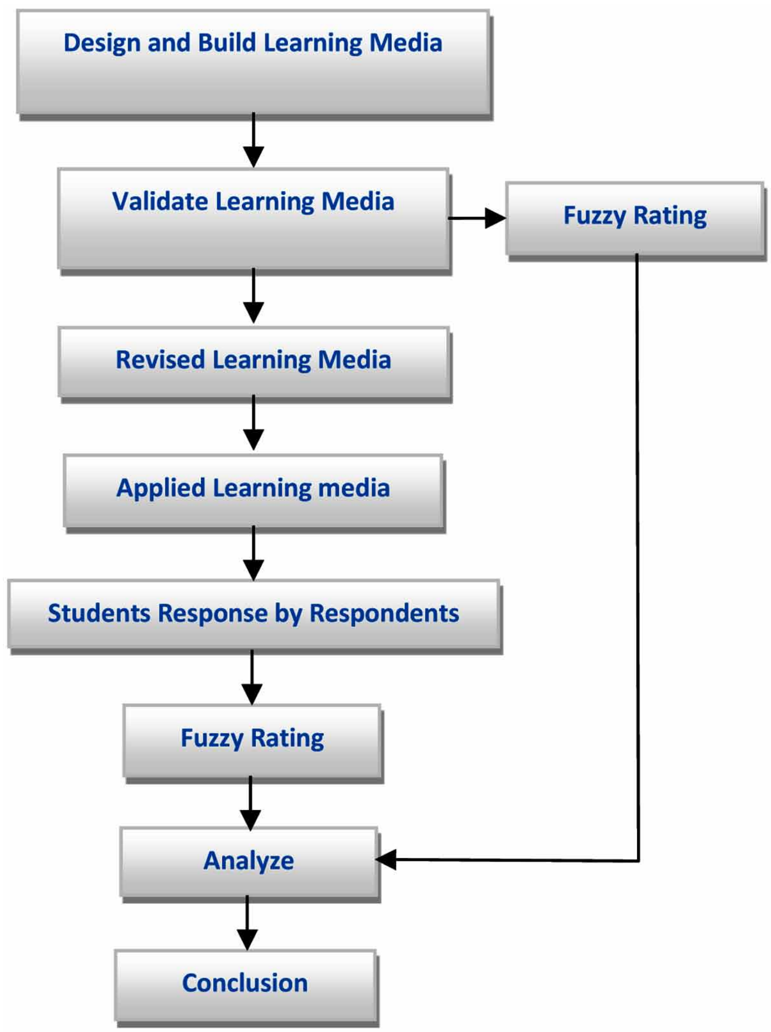
Fuzzy Inferences System (FIS) become popular because of its easiness in help to make decisions. Therefore, FIS has been widely used in various fields. In the health field, Medeiros et al., (2017) used FIS to support medical diagnoses in real time. FIS also is used in education fields, there are García et al., (2017) used FIS to analyze systems for organizational capabilities for innovation in university institutions. Ozdemir et al., (2016) stated that FIS can help to determine the best convenient learning styles of engineering faculty staff and students. FIS also has the ability to develop e-learning systems that used to improved web-based retrieval (Gomathi & Rajamani, 2017). According to Lin et al., (2016), FIS is capable to implement a simple and effective remedial learning system. FIS has the capability to mimic the teacher behavior in order able to organize the learning process more satisfactorily (Aguilar et al., 2010). The FIS basically consists of three sections such as: inputs, fuzzy rule or inference and output. The following is steps to establish FIS (Zen & Jun, 2010):

1. Establish correlating datasets into fuzzy theory
2. Determine linguistic variables and linguistic values of input and output
3. Determine the linguistic value membership function
4. Determine the fuzzy rules or inference
5. Determine fuzzy calculation
6. Get the model output

RESEARCH METHODOLOGY

This study was held on at the 10th grade a vocational school in Indonesia. The study participants consisted of 37 students. Figure 1 shows the steps of the research. It can be depicted that the research steps are: designing and establishing visual programming-based visual learning media to learn programming technique; validating learning media by experts' judgment. In this step, experts' judgment uses linguistic preferences by used FRS; revising visual learning media based on experts' judgment; applying visual learning media. In this step visual learning media is applied in the class; Students' response. In this

Figure 1. Research methodology block diagram

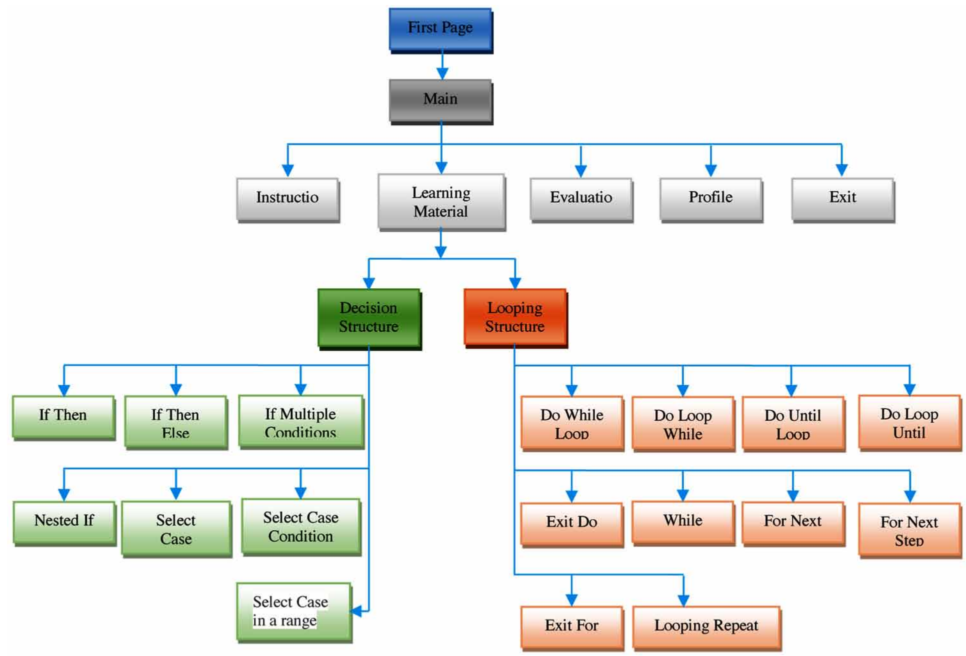


step is to measure students' response by used their preferences toward the use of visual learning media. Students' response uses linguistic preferences by used FRS. Analyze, in this step, the FIS method is used to analyze experts' decision on revised visual learning media and also to investigate students' decision on the visual learning media usage. The last step is the conclusion.

Establish Visual Programming as Visual Learning Media

Based on the study of kinds of literature, it can be resumed that visual learning media has some advantages to help students to learn a subject. Therefore, to give practice students in learning programming techniques subject, the visual learning media was built based on visual programming. The visual programming for this study used visual basic programming. Figure 2 shows the design of the learning media outline. The learning media outline covers several pages such as the initial page that contains the opening display of learning media. The main page contents some pages such as instruction page, learning materials page,

Figure 2. The learning media outline



evaluation page, and profile page. Instruction page gives guidance in the implementation of the learning media, such as information about the function of an icon and how it works and also explains how to browse the page in the learning media. In the learning materials page contains two materials namely decision structure and looping structure.

Figure 3 indicates the menu display of visual learning media. It can be seen in Figure 3, there are some icon navigations that refer to the content of the visual media learning. The icon navigations are instruction icon, learning material icon, an evaluation icon, profile icon, and exit icon.

The students applied visual programming-based visual media learning to learn programming technique in the class. The students learned visual media learning directly, so they can simulate the execution a list of computer programming and also able to follow what teacher order to do. This learning activity is shown in Figure 4.

Figure 5 shows a flowchart about learning to use the select-case command. The page also features a video project to see the procedures and results of using the select-case command in order to increase student understanding.

Figure 6 shows the select-case command learning in the case of calculating the ohm resistor value. It can be seen in visual learning media there is a box that can be filled by students with a series of programs using the command select-case. After completing typing a series of programs, the students can press the process icon to execute the program. If the writing of the program is correct then the results of the execution will be carried out and if wrong then there is a warning that the program created is wrong.

Figure 3. Menu display of visual learning media

Figure 4. The students' activity while use visual programming

Validate Visual Learning Media

The process of validation is needed to enhance quality from a preliminary version of visual learning media before it is used in the class. In this step, the aims of validation are 1) to investigate the visual learning media feasibility and 2) to have experts' feedback so that can rectify the weakness of visual learning media. Validation of the questionnaire is held in order to investigate face validity, content validity and

Figure 5. Flowchart of the select case the learning material

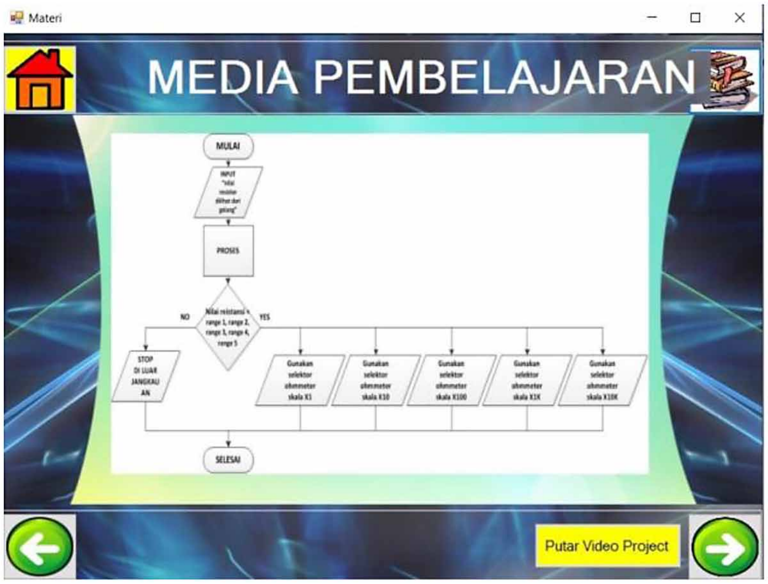
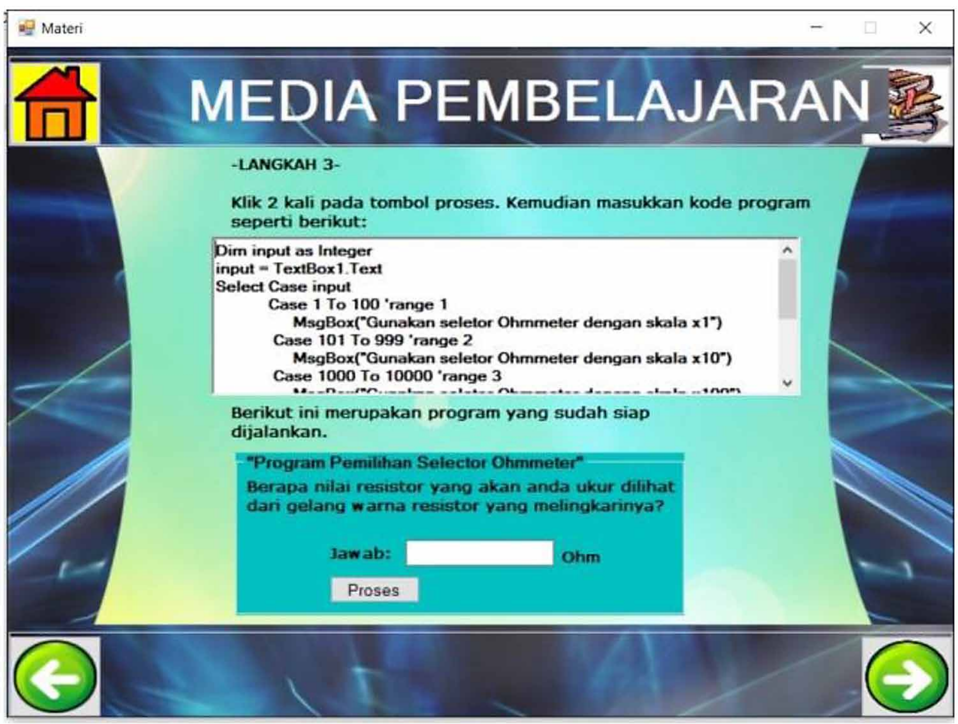


Figure 6. Select case the learning material



construct validity. To commence the validity process, three experts of media learning were invited. They gave some reviews for the questionnaire that correlated with face and content of visual media learning and gave reviews about the visual media learning constructs such as media format, media design, learning material, and language. The reviews were done on each item in the questionnaire. The process of validation was an iterative procedure in order to assess the suitable words and also to understand the meaning of each indicator so that can identify a specific feature of visual media learning that was evaluated. In consequence of this procedure, several corrections were done in order to rectify the weakness of visual learning media. The sheet of questionnaire validation for visual learning media is indicated in Table 1. The questionnaire sheet consists of two assess rating namely rating aspects and rating preferences.

Student's Response

The ways to validate the questionnaire student's response are the same with the ways to validate the visual learning media. Three experts reviewed the student's response questionnaire and then give their feedback to improve the student's response constructs for each indicator. In consequence of these steps, several corrections were held to correct the weakness of student's response questionnaire. Table 2 indicates the students' response questionnaire validation that consists of rating aspects and rating preferences. Furthermore, the three experts used linguistic variables to fill in the rating preferences for visual learning media questionnaire validation and students' response questionnaire validation. The linguistic variables that are used to fill in the rating preferences are Strongly Disagree (SD), Disagree (D), Agree (A) and Strongly Agree (SA).

RESULTS

Experts Validation

One of the advantages of fuzzy is the ability to transfer linguistic preferences toward fuzzy value. In this study, the fuzzy values are obtained from both questionnaire validations that filled in by the experts. The three experts give their preferences toward the validation of the questionnaire. Furthermore, the fuzzy values become input for the FIS. In this study, the FIS is built based on the steps on (Zen & Jun, 2010). These steps are used to build the FIS to assess media format aspect. Furthermore, these steps were also used to rating other aspects of visual learning media.

1. **Establish Correlating Datasets Into Fuzzy Theory:** The fuzzy values from expert preferences become input for FIS. Then FIS process those fuzzy values become an output for the aspect of media format. Table 1 indicates the media format with 5 indicators namely MF1, MF2, MF3, MF4, and MF5. The Mamdani method is used for all procedure for setting up the FIS. Next, the FIS output calculation only has one output (Validity). The output value can be a category as a decision for the validity of aspects in visual learning media. Correlated data sets that convert to the FIS are indicated in Figure 7.
2. **Determine Linguistic Variables and Linguistic Values of Input and Output:** Linguistic variables as inputs are implemented for media format indicators. They have four variables such as MF1 ={Strongly Disagree (SD), Disagree (D) Agree (A), Strongly Agree (SA)}, MF2= {Strongly

Table 1. The sheet of questionnaire validation

	Rating Aspects	**Rating Preferences**			
Indicators	**Media Format**	**Strongly Disagree (SD)**	**Disagree (D)**	**Agree (A)**	**Strongly Agree (SA)**
MF1	a. The learning media are presented systematically				
MF2	b. The use of letters of instructional media is clear				
MF3	c. The image size in instructional media is conform				
MF4	d. The usefulness of learning media is effective and efficient				
MF5	e. The layout of learning media is compatible				
	Media Design	**Strongly Disagree (SD)**	**Disagree (D)**	**Agree (A)**	**Strongly Agree (SA)**
MD1	a. The video project that displayed in the learning media is able to help student understanding				
MD2	b. The illustrations are presented in a clear, attractive and easy to understand.				
MD3	c. The display of media design with matching colors is presented				
MD4	d. The navigation menu is easy to use				
	Learning Material	**Strongly Disagree (SD)**	**Disagree (D)**	**Agree (A)**	**Strongly Agree (SA)**
LM1	a. The learning materials are conformity with indicators				
LM2	b. The learning media are linkages with the purpose of learning				
LM3	c. The contents of learning materials are in accordance with the field of study				
LM4	d. The sequence of instructional media of the learning material in each section is compatible				
LM5	e. The information that is delivered through images on learning media is explicit				
	Language	**Strongly Disagree (SD)**	**Disagree (D)**	**Agree (A)**	**Strongly Agree (SA)**
L1	a. The language is easily understood				
L2	b. The language in media learning is appropriate with Indonesian Grammar				
L3	c. The language used is able to clarify the learning materials delivered				

Disagree (SD), Disagree (D) Agree (A), Strongly Agree (SA)},MF3={ Strongly Disagree (SD), Disagree (D) Agree (A), Strongly Agree (SA)},MF4={ Strongly Disagree (SD), Disagree (D) Agree (A), Strongly Agree (SA)} and MF5={ Strongly Disagree (SD), Disagree (D) Agree (A), Strongly Agree (SA)}. Figure 8 indicates the input of fuzzy membership function. Furthermore, linguistic variables as output (Validity) have four categories such are Very Not Valid (VNV), Not Valid (NV), Valid (V), Very Valid (VV). Figure 9 indicates fuzzy membership function output.

Table 2. Questionnaire validation for student's response

	Rating Aspects	Rating Preferences			
Indicators	**Media Design**	**Strongly Disagree (SD)**	**Disagree (D)**	**Agree (A)**	**Strongly Agree (SA)**
M1	a. The video project that displayed in the learning media is able to help student understanding				
M2	b. The illustrations are presented in a clear, attractive and easy to understand.				
M3	c. The display of media design with matching colors is presented				
M4	d. The navigation menu is easy to use				
M5	e. The learning media are attractive				
	The Content of Learning Media	**Strongly Disagree (SD)**	**Disagree (D)**	**Agree (A)**	**Strongly Agree (SA)**
C1	a. The learning materials are conforming with learning indicators				
C2	b. The language used in the media is easy to understand				
C3	c. The information that is delivered through images on learning media is explicit				
C4	d. The learning media are able to help students to understand the learning materials easier				
	Metacognitive Abilities	**Strongly Disagree (SD)**	**Disagree (D)**	**Agree (A)**	**Strongly Agree (SA)**
MT1	a. The learning media are able to attract the student interest				
MT2	b. The learning media are able to grow the learning interest				
MT3	c. The learning media are able to enhance students' understanding				
MT4	d. The learning media are able to delight students to study the learning material				

3. 3. **Determine the Linguistic Value Membership Function:** In this study, the type of fuzzy memberships used two types. The two types of fuzzy memberships are the type of triangle membership and the type of trapezoidal membership that refer to (Li, 2013). Triangle membership function formula can be seen in (eq. 1).

$$f\left(x,a,b,c\right)=\begin{cases} 0, x \le a \\ \dfrac{x-a}{b-a}, a \le x \le b \\ \dfrac{c-x}{c-b}, b \le x \le c \\ 0, c \ll x \end{cases} \quad (1)$$

Figure 7. Corresponding data sets into the FIS

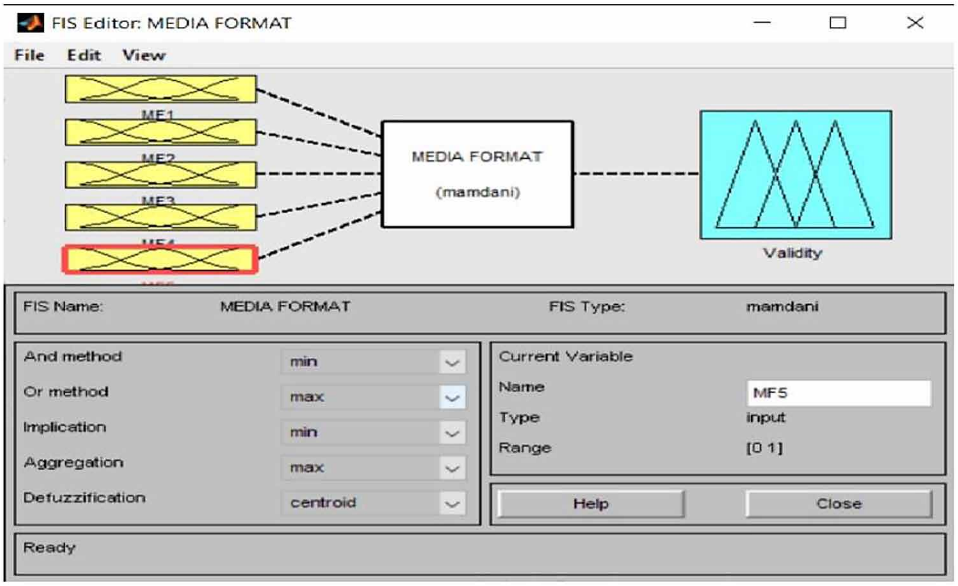
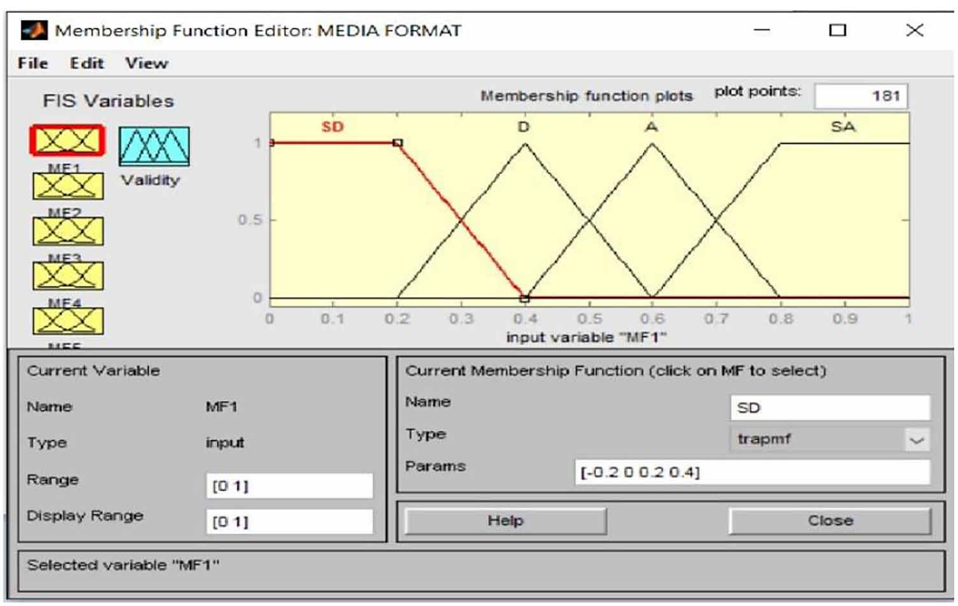
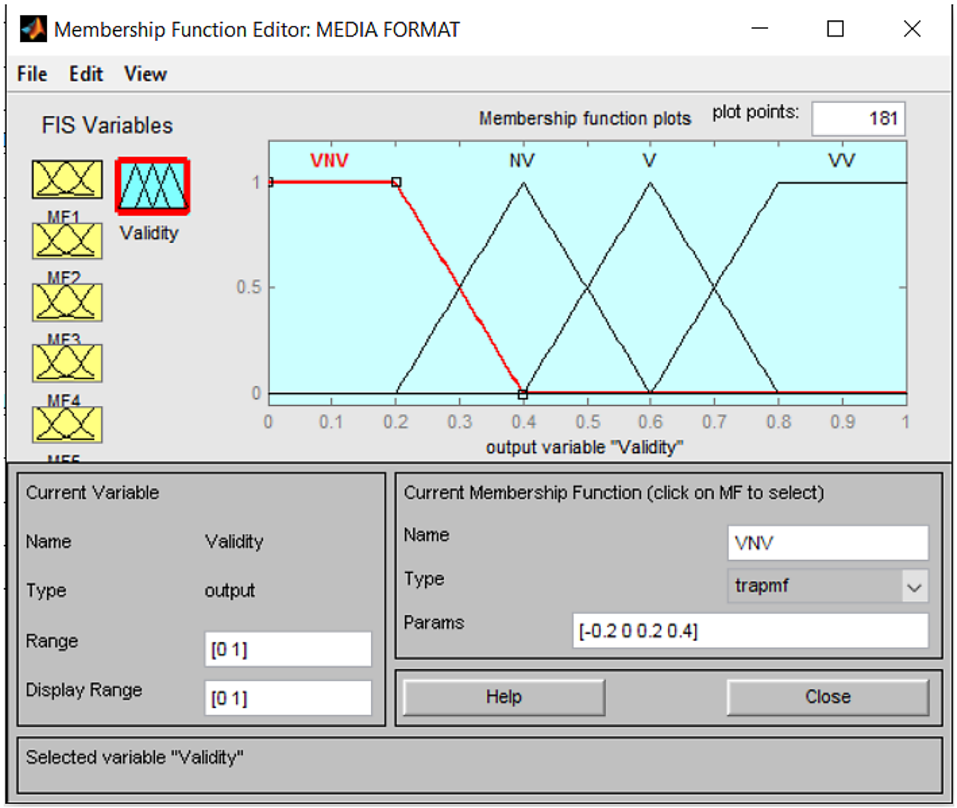


Figure 8. Fuzzy membership function input for media format



The equation 1 is used when the input or output membership functions implement membership functions triangle type. For example in the input side, if the linguistic value is Disagree (D) so the degree of its membership is (0.2 0.4 0.6). If the linguistic value is Agree (A) so the degree of its membership is (0.4 0.6 0.8). It also happens in the output side, if the linguistic value is Not Valid (NV) so the degree

Figure 9. Fuzzy membership function output for media format



of its membership is (0.2 0.4 0.6). If the linguistic value is Valid (V) so the degree of its membership is (0.4 0.6 0.8). Next, for trapezoidal membership functions, the formula for is written as equation 2.

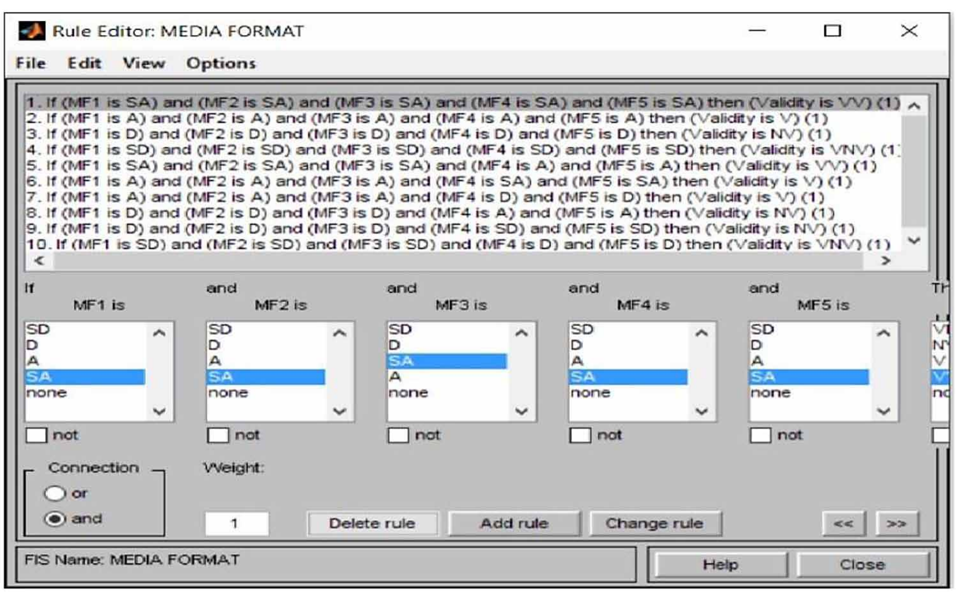
$$\left(x,a,b,c,d\right)=\begin{cases}0, & x\le a\\ \dfrac{x-a}{b-a}, a\le x\le b & \\ 1,\ b\le x\le c & \\ \dfrac{d-x}{d-c}, c\le x\le d & \\ 0, & d\ll x\end{cases} \quad (2)$$

When the input or output membership functions implement membership functions trapezoidal type. Therefore, it must use equation 2. For example in the input side, if the linguistic value is Strongly Disagree (D) so the degree of its membership is (-0.2 0.0 0.2 0.4). If the linguistic value is Strongly Agree (A) so the degree of its membership is (0.6 0.8 1.0 1.2). It also happens in the output side, if the linguistic value is Very Not Valid (VNV) so the degree of its membership is (-0.2 0.0 0.2 0.4). If the linguistic value is Very Valid (VV) so the degree of its membership is (0.6 0.8 1.0 1.2).

4. **Determine the Fuzzy Rules or Inference:** In this step, the study builds fuzzy rules that consist of 10 rules. The rules are as follows:
   a. If (MF1 is SA) and (MF2 is SA) and (MF3 is SA) and (MF4 is SA) and (MF5 is SA) then (Validity is VV)
   b. If (MF1 is A) and (MF2 is A) and (MF3 is A) and (MF4 is A) and (MF5 is A) then (Validity is V)
   c. If (MF1 is D) and (MF2 is D) and (MF3 is D) and (MF4 is D) and (MF5 is D) then (Validity is NV)
   d. If (MF1 is SD) and (MF2 is SD) and (MF3 is SD) and (MF4 is SD) and (MF5 is SD) then (Validity is VNV)
   e. If (MF1 is SA) and (MF2 is SA) and (MF3 is SA) and (MF4 is A) and (MF5 is A) then (Validity is VV)
   f. If (MF1 is A) and (MF2 is A) and (MF3 is A) and (MF4 is SA) and (MF5 is SA) then (Validity is V)
   g. If (MF1 is A) and (MF2 is A) and (MF3 is A) and (MF4 is D) and (MF5 is D) then (Validity is V)
   h. If (MF1 is D) and (MF2 is D) and (MF3 is D) and (MF4 is A) and (MF5 is A) then (Validity is NV)
   i. If (MF1 is D) and (MF2 is D) and (MF3 is D) and (MF4 is SD) and (MF5 is SD) then (Validity is NV)
   j. If (MF1 is SD) and (MF2 is SD) and (MF3 is SD) and (MF4 is D) and (MF5 is D) then (Validity is VNV)

Figure 10 shows the 10 rules that used rule editor from Matlab R2008A to build of fuzzy rules.

Figure 10. Fuzzy rule for media format



The fuzzy calculation process uses Mamdani method as can be seen in step e and f. Next, the calculation result shows as the output. Figure 11 shows the process of calculation from one of the expert's preferences toward the aspects of media format. The expert's preferences for the indicators are as follow: MF1= Strongly Agree (0.9), MF2= Strongly Agree (0.9), MF3= Strongly Agree (0.9), MF4= Agree (0.7) and MF5= Agree (0.7). Thereafter, the validity output result is Very Valid (0.826).

Next, these steps for calculating FIS are used to validate visual learning media. Three experts give their fuzzy preferences toward media format aspect, learning material aspect, media design aspect, and language aspect as seen in Table 3, Table 4, Table 5 and Table 6 respectively. Table 3 shows fuzzy preferences from the experts with the input indicators are MF1, MF2, MF3, MF4, and MF5 and the output indicator is Validity. Table 3 indicates that the first expert provides his fuzzy preferences to the indicator. The first expert's preferences are MF1 = Agree, MF2 = Agree, MF3 = Agree, MF4 = Strongly Agree, MF5 = Agree. Calculation result shows the fuzzy calculation output is 0.727 with Valid validity. Then, the second expert provides his fuzzy preferences to the indicator. The second expert's preferences are MF1= Strongly Agree, MF2= Strongly Agree, MF3= Agree, MF4= Strongly Agree and MF5= Strongly Agree. Calculation result shows the fuzzy calculation output is 0826 with Very Valid validity. Hereinafter, the third expert provides his fuzzy preferences to the indicator MF1= Strongly Agree, MF2= Strongly Agree, MF3= Strongly Agree, MF4= Agree and MF5= Agree. Calculation result shows the

Figure 11. Fuzzy calculation and output result of FIS from the aspect of media format

Table 3. Experts' fuzzy preferences for media format aspect

Media Format						
Expert	**MF1**	**MF2**	**MF3**	**MF4**	**MF5**	**Validity**
1	A	A	A	SA	A	V (0.727)
2	SA	SA	A	SA	SA	VV (0.826)
3	SA	SA	SA	A	A	VV (0.826)
Average						VV (0.793)

Table 4. Experts' fuzzy preferences for learning material aspect

Learning Material						
Expert	**LM1**	**LM2**	**LM3**	**LM4**	**LM5**	**Validity**
1	SA	A	A	A	A	VV (0.826)
2	A	SA	SA	SA	SA	VV (0.826)
3	A	A	SA	SA	SA	VV (0.826)
Average						VV (0.826)

Table 5. Experts' fuzzy preferences for media design aspect

Media Design					
Expert	MD1	MD2	MD3	MD4	Validity
1	A	A	A	A	V (0.727)
2	SA	SA	SA	SA	VV (0.847)
3	SA	SA	SA	SA	VV (0.847)
Average					VV (0.807)

Table 6. Experts' fuzzy preferences for language aspect

Language				
Expert	**L1**	**L2**	**L3**	**Validity**
1	A	A	A	V (0.727)
2	SA	SA	SA	VV (0.847)
3	SA	SA	SA	VV (0.847)
Average				VV (0.807)

fuzzy calculation output is 0826 with Very Valid validity. Meanwhile, the average calculation result of the validity of the experts is 0.793 with Very Valid validity.

Table 4 indicates the three experts' fuzzy preferences on the aspect of learning material. The indicators are LM1, LM2, LM3, LM4, and LM5 and the output is Validity. The first expert provides his fuzzy preferences to the indicator are as follows: LM1 = Strongly Agree, LM2 = Agree, LM3 = Agree, LM4 = Agree, LM5 = Agree. Calculation result shows the fuzzy calculation output is 0.826 with Very Valid validity. Next, the second expert gives his preferences to the indicator LM1= Agree, LM2= Strongly Agree, LM3= Strongly Agree, LM4= Strongly Agree and LM5= Strongly Agree. Calculation result shows the fuzzy calculation output is 0.826 with Very Valid validity, with the same way, the third expert gives his preferences to the indicator LM1= Agree, LM2= Agree, LM3= Strongly Agree, LM4= Strongly Agree and LM5= Strongly Agree. Calculation result shows the fuzzy calculation output is 0.826 with Very Valid validity. Meanwhile, the average calculation result of the validity of the experts is 0.826 with Very Valid validity.

Table 5 indicates the three experts' fuzzy preferences on the aspect of media design. The indicators are MD1, MD 2, MD3, and MD 4 and the output is Validity. From Table 5, it can be seen that the first expert provides his fuzzy preferences are as follows: MD 1 = Agree, MD2 = Agree, MD3 = Agree, MD4 = Agree. Calculation result shows the fuzzy calculation output is 0.727 with Valid validity. Next, the second expert provides his fuzzy preferences to the indicator are as follows MD1= Strongly Agree, MD2= Strongly Agree, MD3= Strongly Agree, and MD4= Strongly Agree. Calculation result shows the fuzzy calculation output is 0.847 with Very Valid validity, with the same way, the third expert provides his fuzzy preferences to the indicator are as follows MD1= Strongly Agree, MD2= Strongly Agree, MD3= Strongly Agree, and MD4= Strongly Agree. Calculation result shows the fuzzy calculation output is 0.847 with Very Valid validity. Meanwhile, the average calculation result of the validity of the experts is 0.807 with Very Valid validity.

Table 6 shows the three experts' fuzzy preferences on an aspect of language. The indicators are L1, L2, and L3 and the output is Validity. From Table 6, it can be seen that the first expert provides his fuzzy preferences to the indicator are as follows: L1 = Agree, L2 = Agree, L3 = Agree. Calculation result shows the fuzzy calculation output is 0.727 with Valid validity. Next, the second expert provides his fuzzy preferences to the indicator are as follows: L1= Strongly Agree, L2= Strongly Agree, and L3= Strongly Agree. Calculation result shows the fuzzy calculation output is 0.847 with Very Valid validity, in a similar way, the third expert provides his fuzzy preferences to the indicator are as follows: L1= Strongly Agree, L2= Strongly Agree, and L3= Strongly Agree Calculation result shows the fuzzy calculation output is 0.847 with Very Valid validity. Meanwhile, the average calculation result of the validity of the experts is 0.807 with Very Valid validity.

Student's Response

With the same steps as in Zen and Jun (2010), the steps are used to build FIS for the student's response. Figure 12 depicts the fuzzy membership function input for the aspect of media design for student's response. It can be seen that fuzzy membership function for Strongly Degree (SD) with the trapezoidal type that is represented with red line shows the range at [0, 0, 0.2, and 0.4]. Figure 13 depicts the fuzzy membership function output for the aspect of media design for student's response. It can be seen that fuzzy membership function for Very Bad (VB) with the trapezoidal type that is represented with red line shows the range also at [0, 0, 0.2, and 0.4].

Figure 14 indicates the fuzzy rules for student's response toward media design. The fuzzy rules consist of ten rules. Figure 15 shows the snapshot of fuzzy calculation of student's response and the FIS output result of student's response for the aspect of media design.

Figure 12. Fuzzy input for the aspect of media design

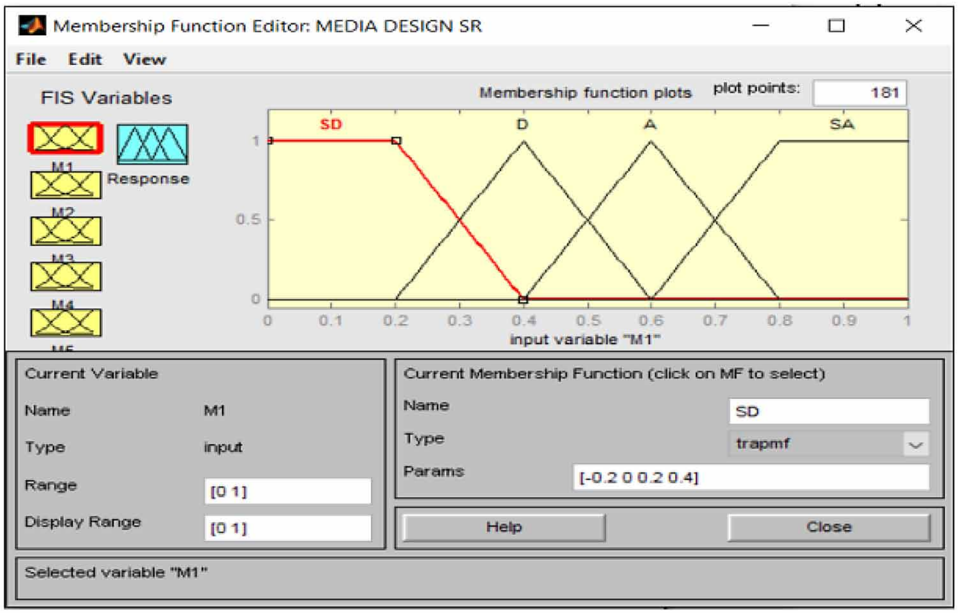


Figure 13. Fuzzy output for the aspect of media design

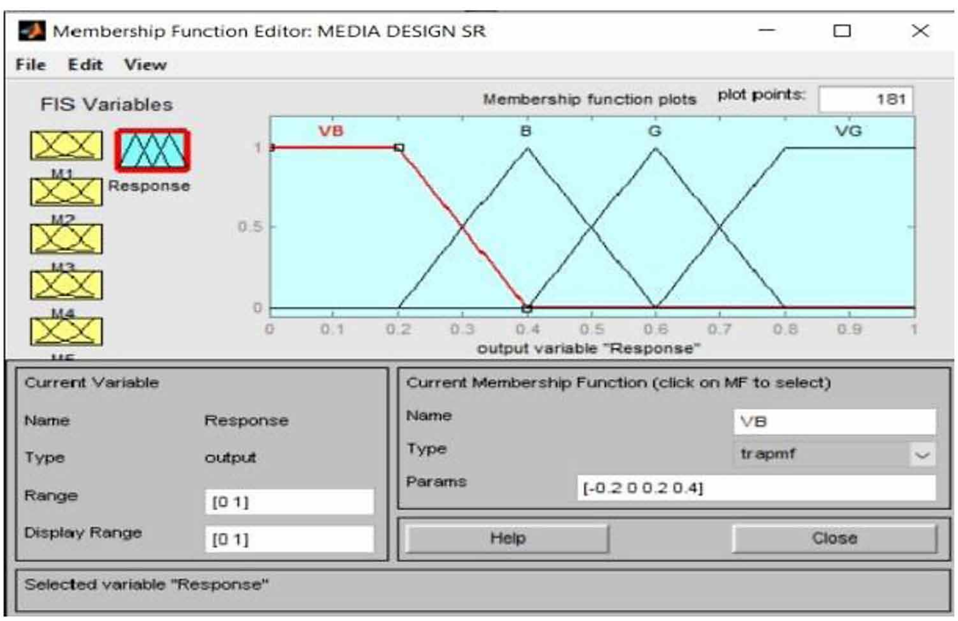


Table 7 shows 37 students' fuzzy preferences on the aspect of media design. The media design aspect has indicators such as M1, M2, M3, M4, and M5. Then, the students give their preferences in the fuzzy rating scale toward indicators media design aspect. The output result from the fuzzy calculation is a category of the media design aspect. For example for calculation from the table 7, it can be seen that

Figure 14. Fuzzy rule base for the aspect of media design

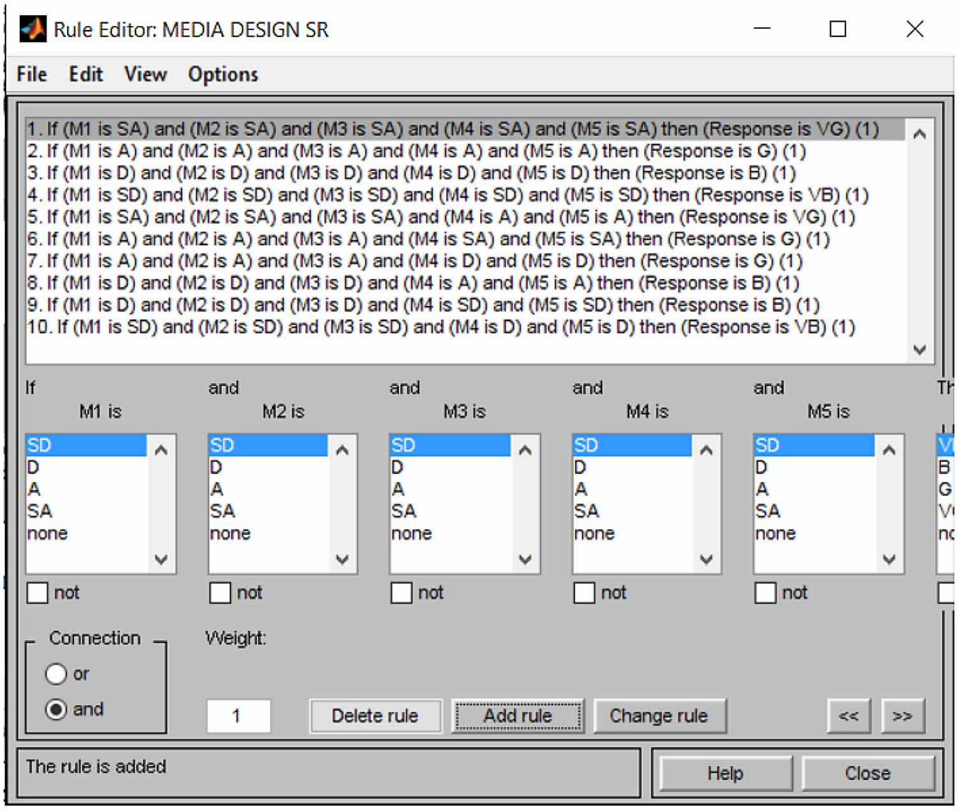


Figure 15. FIS calculation of student's response

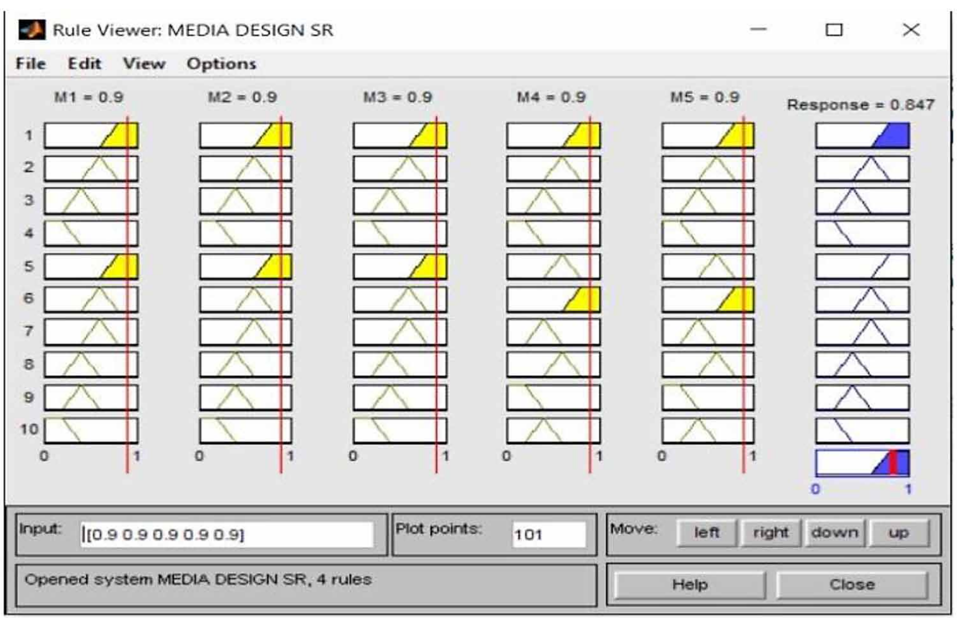


Table 7. Students' response with fuzzy preferences for media design aspect

Media Design						
Student ID	**M1**	**M2**	**M3**	**M4**	**M5**	**Category**
1	SA	SA	SA	SA	SA	VG(0.847)
2	A	A	A	A	A	G(0.727)
3	A	SA	A	A	SA	VG(0.826)
4	A	A	A	A	A	G(0.727)
5	SA	SA	SA	SA	SA	VG(0.847)
6	SA	A	A	SA	SA	VG(0.826)
7	SA	A	A	A	A	VG(0.826)
8	A	A	D	D	A	G(0.5)
9	SA	SA	SA	SA	SA	VG(0.847)
10	SA	SA	SA	SA	SA	VG(0.847)
11	SA	SA	SA	SA	SA	VG(0.847)
12	A	D	SA	SA	D	G(0.5)
13	SA	SA	SA	SA	SA	VG(0.847)
14	A	A	A	A	A	G(0.727)
15	SA	SA	SA	SA	SA	VG(0.847)
16	A	A	SA	A	SA	VG(0.826)
17	A	A	A	A	A	G(0.727)
18	A	A	A	A	A	G(0.727)
19	SA	SA	SA	SA	SA	VG(0.847)
20	A	D	A	SA	D	G(0.5)
21	A	A	A	A	A	G(0.727)
22	A	A	A	A	A	G(0.727)
23	SA	A	A	A	A	VG(0.826)
24	SA	SA	SA	SA	A	VG(0.826)
25	A	A	A	A	SA	G(0.727)
26	A	A	A	A	A	G(0.727)
27	SA	SA	A	SA	SA	VG(0.826)
28	SA	A	A	SA	A	VG(0.826)
29	SA	SA	SA	SA	SA	VG(0.847)
30	A	SA	A	A	SA	VG(0.826)
31	SA	A	A	D	SA	G(0.5)
32	A	A	A	A	A	G(0.727)
33	SA	A	A	D	SA	G(0.5)
34	SA	SA	SA	SA	A	VG(0.826)
35	A	A	A	A	A	G(0.727)
36	SA	SA	A	SA	SA	VG(0.826)
37	A	A	A	A	A	G(0.727)
					Average	VG(0.755)

the student ID number 1 has fuzzy preferences for the indicators such as M1 = Strongly Agree, M2 = Strongly Agree, M3 = Strongly Agree, M4 = Strongly Agree, M5 = Strongly Agree. Calculation result shows the output of fuzzy calculation is 0.847 with VG (Very Good) category. In the same way, fuzzy preferences of all students' response are calculated in order to obtain the result of the response value. Next, all response values are calculated to obtain the average value. The average of the response for media design aspect is 0.807 with VG (Very Good) category.

The next analyse is for students' response with fuzzy preferences for content learning media aspect. Table 8 shows 37 students' fuzzy preferences on the aspect of content learning media. The content learning media aspect has indicators such as C1, C2, C3, and C4. Furthermore, the students give their preferences in the fuzzy rating scale toward indicators media design aspect. The output result from the fuzzy calculation is a category of the media design aspect. For example for calculation from the table 8, it can be seen that the student ID number 1 has fuzzy preferences for the indicators such as: C1 = Agree, C2 = Strongly Agree, C3 = Strongly Agree, C4 = Strongly Agree. Calculation result shows the output of fuzzy calculation is 0.826 with VG (Very Good) category. In the same way, fuzzy preferences of all students' response are calculated in order to obtain the result of the response value. Then, all response values are calculated to obtain the average value. The average of the response for media design aspect is 0.733 with VG (Very Good) category.

The next analyse is for students' response with fuzzy preferences for metacognitive abilities aspect. Table 9 shows 37 students' fuzzy preferences on the aspect of for metacognitive abilities. The metacognitive abilities aspect has indicators such as MT1, MT2, MT3, and MT4. Furthermore, the students give their preferences in the fuzzy rating scale toward indicators media design aspect. The output result from the fuzzy calculation is a category of the media design aspect. For example for calculation from the table 9, it can be seen that the student ID number 1 has fuzzy preferences for the indicators such as MT1 = Strongly Agree, MT2 = Strongly Agree, MT3 = Strongly Agree, MT4 = Strongly Agree. Calculation result shows the output of fuzzy calculation is 0.847 with VG (Very Good) category. In the same way, fuzzy preferences of all students' response are calculated in order to obtain the result of the response value. Then, all response values are calculated to obtain the average value. The average of the response for media design aspect is 0.732 with VG (Very Good) category.

CONCLUSION

In this study, three experts validated visual programming-based visual learning media. Validation is held to inquiry the feasibility of visual learning media. Visual learning media validation is comprised of 4 aspects such as media format aspect, learning material aspect, media design aspect, and language aspect. The three experts used fuzzy preferences to rate the validation of these four aspects. The results show that the average value from three experts based on fuzzy preferences from each aspect is as follows: the average value for the media format aspect is 0793 by validity Very Valid, the average value for the learning material aspect is 0.826 by validity Very Valid, the average value for media design aspect is 0.807 by validity Very Valid, and value average for the language aspect is 0.807 by validity Very Valid. From the experts' fuzzy preferences calculation for these four aspects show that visual programming-based visual learning media is feasible.

Table 8. Students' response with fuzzy preferences for content learning media aspect

Content Learning Media					
Student ID	**C1**	**C2**	**C3**	**C4**	**Category**
1	A	SA	SA	SA	VG(0.826)
2	A	A	A	SA	G(0.727)
3	SA	A	D	A	G(0.5)
4	A	A	A	SA	G(0.727)
5	SA	SA	SA	A	VG(0.826)
6	A	A	A	SA	G(0.727)
7	A	A	A	A	G(0.727)
8	A	A	A	D	G(0.5)
9	A	A	SA	SA	VG(0.826)
10	A	SA	SA	A	G(0.727)
11	SA	SA	A	SA	VG(0.826)
12	SA	SA	SA	D	G(0.5)
13	SA	A	SA	SA	VG(0.826)
14	A	A	SA	A	VG(0.826)
15	SA	A	SA	SA	VG(0.826)
16	A	SA	A	SA	VG(0.826)
17	A	A	A	A	G(0.727)
18	A	A	A	A	G(0.727)
19	A	A	SA	SA	VG(0.826)
20	D	D	D	D	B(0.4)
21	A	A	A	A	G(0.727)
22	A	A	A	A	G(0.727)
23	A	A	A	A	G(0.727)
24	SA	SA	SA	A	VG(0.826)
25	A	A	A	A	G(0.727)
26	A	A	A	SA	G(0.727)
27	A	A	SA	SA	VG(0.826)
28	SA	SA	A	SA	VG(0.826)
29	A	SA	A	SA	VG(0.826)
30	A	SA	A	A	VG(0.826)
31	D	A	A	SA	G(0.5)
32	A	A	A	SA	G(0.727)
33	D	A	A	SA	G(0.5)
34	SA	SA	A	A	VG(0.826)
35	A	A	A	A	G(0.727)
36	SA	SA	A	SA	VG(0.826)
37	A	SA	A	A	VG(0.826)
				Average	VG(0.733)

Table 9. Students' response with fuzzy preferences for c aspect

Metacognitive abilities					
Student ID	**MT1**	**MT2**	**MT3**	**MT4**	**Category**
1	SA	SA	SA	SA	VG(0.847)
2	SA	A	A	D	G(0.5)
3	SA	A	A	A	VG(0.826)
4	SA	A	A	D	G(0.5)
5	SA	SA	SA	SA	VG(0.847)
6	A	A	SA	SA	VG(0.826)
7	A	A	SA	A	VG(0.826)
8	A	D	A	D	G(0.6)
9	SA	SA	SA	SA	VG(0.847)
10	SA	SA	A	SA	VG(0.826)
11	A	SA	SA	SA	VG(0.826)
12	D	A	A	A	B(0.5)
13	SA	SA	SA	SA	VG(0.847)
14	A	A	A	A	G(0.727)
15	A	SA	SA	SA	VG(0.826)
16	SA	SA	A	A	VG(0.826)
17	A	A	A	A	G(0.727)
18	A	A	A	A	G(0.727)
19	SA	SA	SA	SA	VG(0.847)
20	SA	A	D	SA	G(0.5)
21	A	A	A	A	G(0.727)
22	A	A	A	A	G(0.727)
23	A	A	SA	A	VG(0.826)
24	A	A	A	A	G(0.727)
25	SA	D	SA	A	G(0.5)
26	SA	A	A	D	G(0.5)
27	SA	SA	A	SA	VG(0.826)
28	A	SA	A	A	G(0.727)
29	SA	A	A	A	VG(0.826)
30	SA	SA	A	A	VG(0.826)
31	A	A	SA	D	G(0.5)
32	A	A	SA	A	VG(0.826)
33	A	A	SA	D	G(0.5)
34	SA	SA	SA	SA	VG(0.847)
35	A	A	A	A	G(0.727)
36	SA	SA	SA	SA	VG(0.847)
37	A	A	SA	A	VG(0.826)
				Average	VG(0.732)

For students' response, a number of 37 students provided their responses toward the visual learning media. The rating students' response to visual learning media refers to 3 aspects such as media design aspect, media learning content aspect, and metacognitive abilities aspect. The results show that the average value from the students based on fuzzy preferences from each aspect is as follows: the average value for media design aspect is 0.755 by category Very Good, the average value for media learning content aspect is 0.733 by category Very Good, and the average for metacognitive abilities aspect is 0.732 by category Very Good. From the fuzzy preferences calculation of students' response to these three aspects show that visual programming-based visual learning media obtain a Very Good response from students for learning subjects of programming techniques. Therefore, based on the rating from experts and students, it can be deduced that visual programming-based visual learning media can be used as learning media for programming techniques subjects in the school of vocational. This study shows that the use of fuzzy preferences can be used to assess the feasibility of learning media and to assess students' response when they used the visual learning media. Fuzzy preferences that use language variables make it easier for respondents to give their ratings.

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