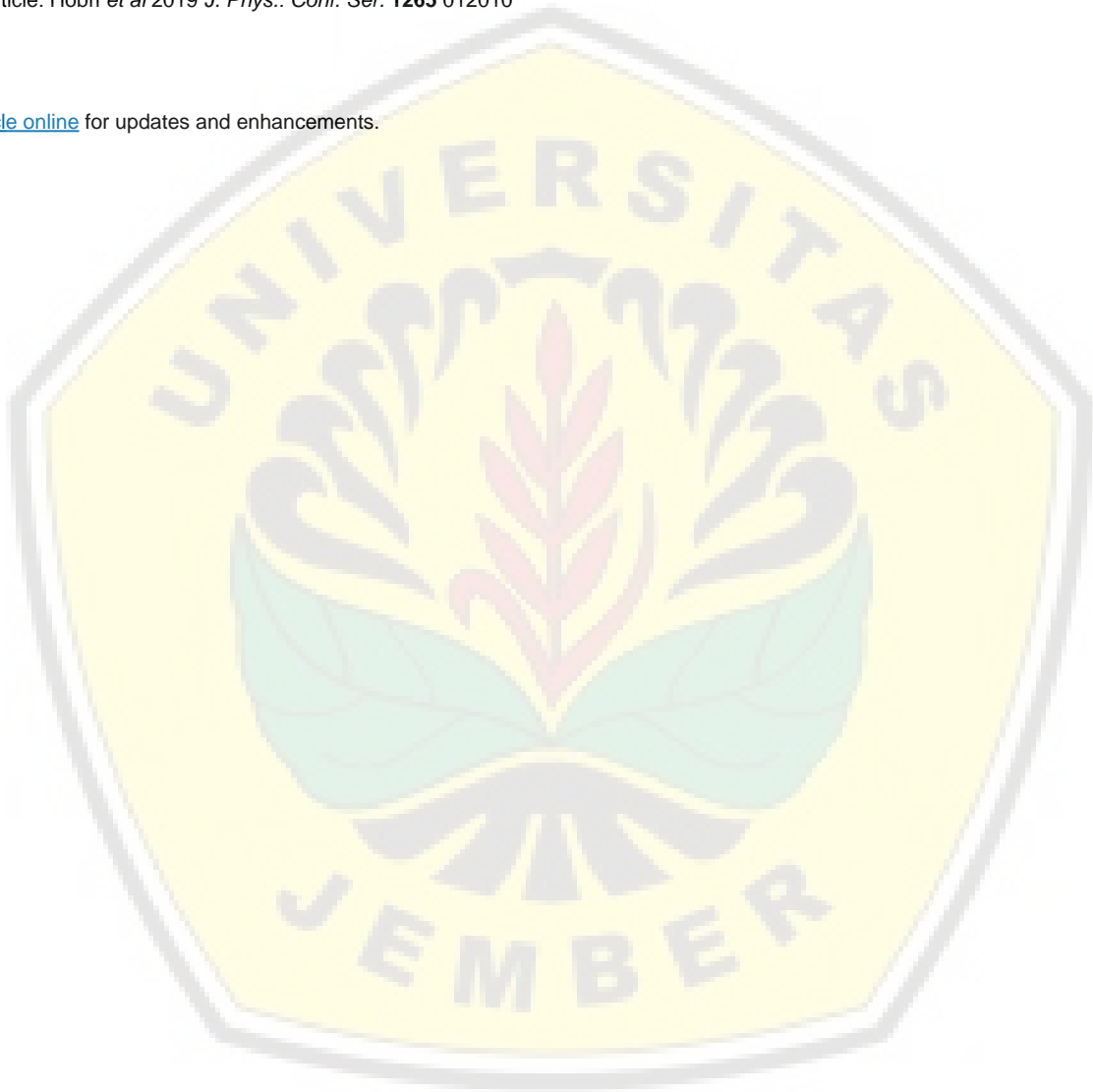


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Development of e-comic using pixton and kelase web on linear program of two variables assisted by geogebra

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Abstract. This study aims to produce a product in the form of e-comic learning media for XI grade senior high school students on linear program of two variable. The learning media developed in this study use Pixton and Kelase assisted by Geogebra which can be accessed online using a computer or android. The process of developing this learning media refers to the Thiagarajan model known as the 4-D model which consists of four stages, namely define, design, develop and disseminate. The results of the comic media validation consisting of aspects of format, content, and language included in the valid criteria with a correlation coefficient value was 0.91. Based on the trials, the results of the use of instructional media including the level of practicality are categorized as good with a percentage was 91.2%. Then the effectiveness results of comic media based on cognitive, psychomoto, and affective aspects obtained effectiveness level of "Good" in all aspects. Cognitive aspects show a percentage of students who scored above the standard score (KKM) was 75%. The total average on the student observation sheet equal to 4.35 with a percentage was 87% in the psychomotor aspect. The last aspect is affective with a percentage was 93.75%.

1. Introduction

Learning media is a tool to deliver the materials to students during teaching and learning process [1]. Media used in learning can generate new desires and interests, increase motivation and stimulate learning activities and bring psychological effects to students, while also helping to improve student understanding [2]. Efforts to improve the quality of learning are something that can not be separated from the responsibility of a teacher [3]. The teacher must have the ability to design and implement various learning strategies including utilizing various learning resources and media to ensure the effectiveness of learning [4]. At present the facts in the field show that students as a whole have not been able to develop their reasoning power in the process of learning mathematics [5]. Reasoning has an important role for individual's thinking process [6]. Therefore, teachers must begin to abandon bad learning habits and move on to learning that can develop and enhance student creativity [7]. This is a challenge for teachers in choosing mathematics learning media that are able to create a pleasant classroom atmosphere and can improve students' reasoning power.

Today the world is facing challenges in the 21st century that are very different from previous centuries where globalization, new technology, and the growth of knowledge in society require citizens to be more creative [8]. In 21st century learning, ICT is one of the skills students must possess [9]. The rapid development of technology today makes many schools use the Electronic Learning (E-Learning) system as their learning media. The use of information technology-based learning media such as e-learning in the teaching and learning process can provide high motivation and satisfaction to students during learning [10].



Technology is something that must be developed by a country in the face of the era of globalization, including in the field of education. Therefore, technology integration with education cannot be avoided [11]. Nowadays technological developments have entered the fourth industrial revolution named after the 4.0 industrial revolution. One program of industrial revolution 4.0 is IoT (Internet of Thing) or IoE (Internet of Everything) [12]. This shows that internet usage is widely used in the 4.0 industrial revolution. Data on internet users in 2014 showed that Indonesia was ranked sixth in the world under China, the United States, India, Brazil and Japan [13]. Entering the era of industrial revolution 4.0, students are now required to be able to take advantage of existing technological advancements [14]. One of the internet-based media that can be used is e-learning based online learning. The use of online media in the classroom produces opportunities that can stimulate and enhance student learning and collaboration [15]. Kelase is a social networking service and provider of online learning spaces that prioritizes social aspects and collaboration, rich learning experiences, facilitates the governance of the education process, monitors the development of the learning process, and bridges communication between teachers, students and parents. In addition to the use of e-learning, design learning must also be as attractive and creative as possible, so students feel comfortable in the learning process. One learning innovation is to use comics as a learning media.

A comic is a series of images included in a box that contains a whole series of stories or forms of storytelling [2], [16]. Comics are not only as entertainment media, but comics can be used as learning media for students. Mathematical comic media was chosen because it has several advantages, namely comics are able to increase students' interest in learning, explanations of material with images and texts make it more interesting, abstract material can be helped by comics, and there are story lines that have certain moral messages [17]. Learning material whose explanation is lengthy and complicated can be packaged with learning media in the form of comics [18]. Educational-based comics can be linked to student problems in everyday life. A two-variable linear program is one of the learning materials that students often encounter in everyday life. Comics have been able to increase student learning attractiveness and have a positive impact on learning because it becomes an attractive medium [19], [20]. Media comic learning has a potential effect to motivate students and improve students' knowledge skills seen from observations and questionnaire results to students [21].

In addition to comics, learning media that can be utilized by teachers to help implement mathematics learning are Geogebra software [22]. Geogebra is the most popular and most used dynamic mathematical software [23]. Geogebra is packaged practically and is easy to use for learning and teaching at all levels of education. Geogebra combines interactive geometry, algebra, tables, graphs, calculus and statistics [24]. Geogebra is very useful as a medium for learning mathematics with a variety of activities, namely as a demonstration and visualization media, as a construction aid, and as a tool for the discovery process [25]. The use of Geogebra in learning can improve students' understanding and learning outcomes [26], [27]. Based on the explanation, this study aims to develop interactive learning media entitled "Development of E-Comic Using Pixton and Kelase Web on Linear Program of Two Variables Assisted by GeoGebra" as a visualization of comics in everyday problems related to two-variable based linear program material e-learning. The renewal of this media is at the end of each e-comic chapter that was created and published at Pixton, was given a GeoGebra Online applet link to help users understand the linear program of two variables material. The resulting comic will be linked to Kelase learning management system (LMS) which can enter mathematical symbols.

2. Research Methods

This type of research is research and development. In development research aims to produce a product that will be tested for validity, practicality, and effectiveness. The development model used is the Thiagarajan model. The Thiagarajan model is known as a 4-D model consisting of four stages. These stages consist of the stages of define, design, develop and disseminate. The research procedure can be seen in Figure 1.

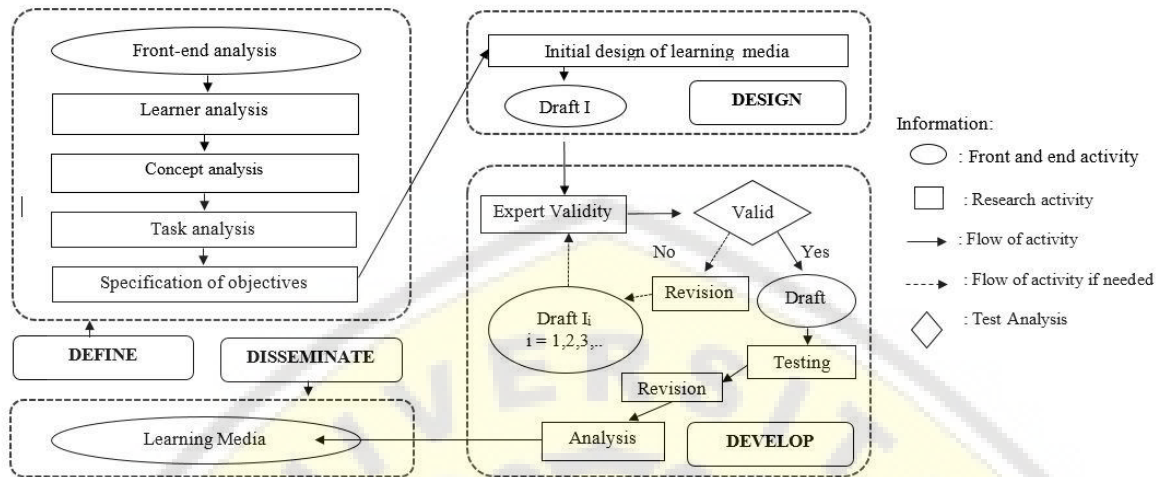


Figure 1. Thiagarajan Model

The development testing was held at MAN 1 Jember in the X-MIPA 4 class with 24 students. Data collection techniques in this study used expert validation, observation, tests, and questionnaires. Sources of data in this study can be seen in Table 1.

Table 1. Research data sources

No	Data	Data Sources
1.	Validity	The media is said to be valid if it meets the validity criteria. Validity is obtained through validation by the validator. The validator in this study were 2 Mathematics Education Lecturers at FKIP University of Jember and a mathematics teacher at MAN 1 Jember
2.	Practicality	The media is said to be practical if the results of the practitioner's observation sheet meet the practicality criteria. Data on media practicality was obtained through interviews and observation sheets for practitioners who were then analyzed.
3.	Effectiveness	The media is said to be effective if it fulfills 3 aspects, namely the first cognitive aspect is analyzed through learning outcomes tests, both psychomotor aspects are analyzed through student observation sheets and the third is affective aspects, namely through student questionnaires.

3. Research and Discussion

This development research produces media that are valid, practical and effective. In the process of developing this media through the definition phase first, after obtaining data about the conditions in the field then enter the design stage to make the initial design of the media. After the initial design of the media is completed, it is entered into the development stage. The development phase starts from validation activities by three experts. After the media is said to be valid, the media is tested. The product developed in this study is e-comic learning media using Geogebra-assisted Pixton and Kelase on the subject of linear two-variable programs. Pixton software is used to make mathematical comics. Comics that have been created are then published through the publish menu provided by Pixton. Comics made in 5 chapters with a total of 15 panels in each chapter with the published display are 3×5 and square for each panel. An example of one of the comics developed can be seen in Figure 2.

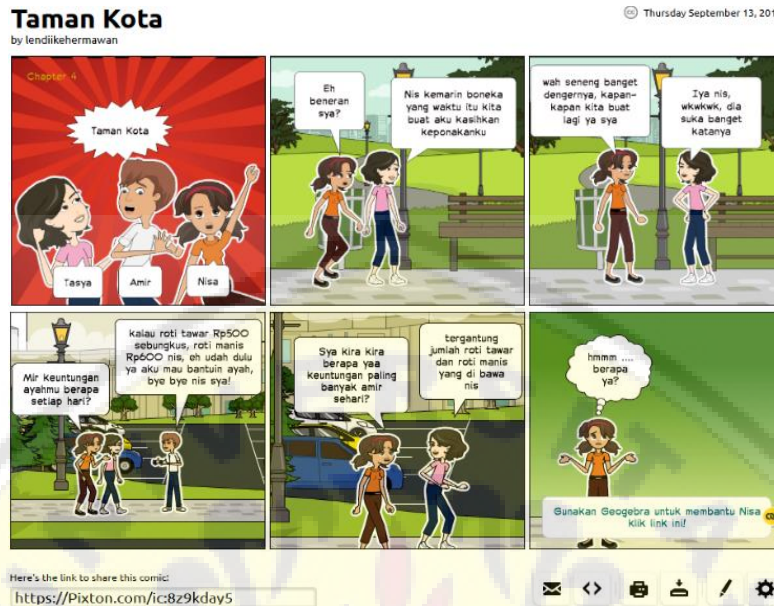


Figure 2. E-Comics that have been developed using Pixton

At the end of each chapter on the comic, it is linked to a Geogebra applet that has been created using Software Geogebra in the format ".ggb" and has been uploaded into a geogebra.org account. The Geogebra Applet developed can be seen in Figure 3. The e-comic learning media link is then linked to the Kelase Learning Management System so students can discuss through the discussion forums provided at Kelase. The appearance of the Kelase online web class can be seen in Figure 4. After learning using e-comic media, an online learning test will be conducted using the exam feature in Kelase. To view the media, open www.kelase.com then enter with id: *learningmedia* and password: *e-comic123*.

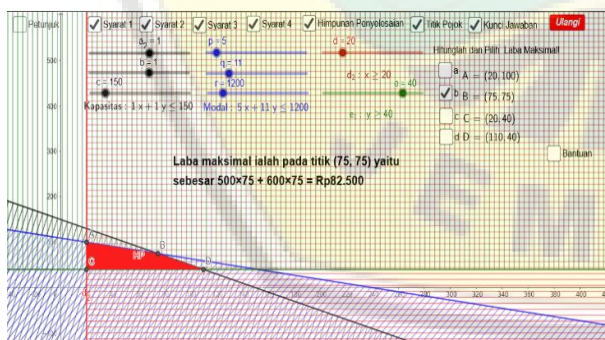


Figure 3. Display of Gogebra Applets that have been developed

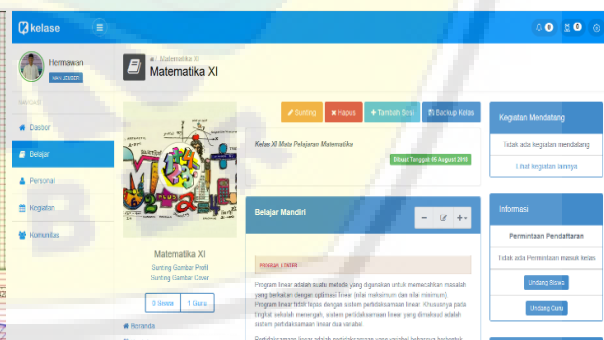


Figure 4. Display Kelase that has been developed

3.1. Validity and Media Analysis

The validation process is done by submitting the research instrument in the form of a validation sheet to each validator. Validation activities are carried out by 3 validators. Based on the validation results of the three validators, the e-comic media using Pixton and Kelase assisted by Geogebra can be categorized very well and can be used with a slight revision. The results of data analysis show that the average total validity of the development of learning media is 4.57 or the correlation coefficient value is 0.91 including the category of "Very High". It can be concluded that e-comic media using Pixton and Kelase assisted by Geogebra was declared valid. Meanwhile the results of the research instrument validation showed a

"Very High" category where the average total validation for interview guidelines reached 4.58 or a correlation coefficient value of 0.92. The average validation of the observation sheet is 4.47 or the correlation coefficient value is 0.89. Whereas the validation of the Lesson Plan reaches 4.61 or the correlation coefficient value is 0.92. Media that obtain validity with very high criteria is worthy of being used in the learning process [28]. The results of media validation for each indicator can be seen in Figure 5.

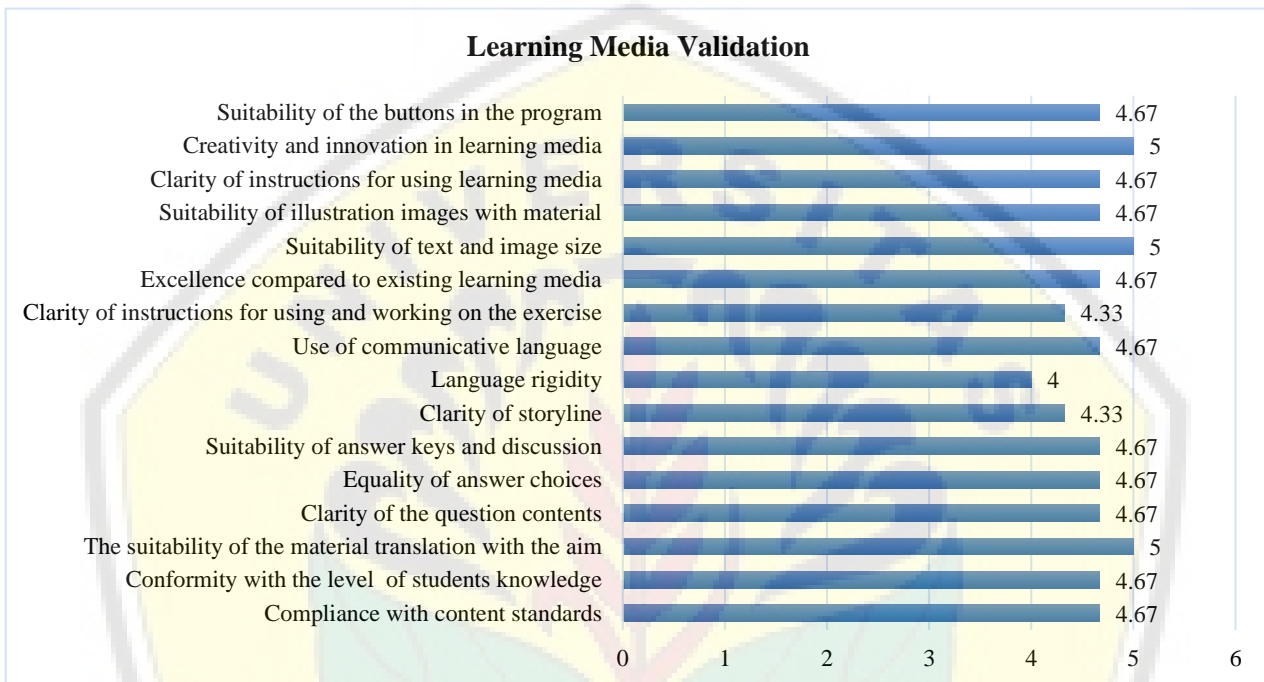


Figure 5. Results of Learning Media Validation

3.2. Media practicality Analysis

The practicality analysis of e-comic media using Pixton and Kelase assisted by Geogebra through an observation sheet where at the time of implementation there were 5 observers who conducted the assessment. The observed part includes the ability of the practitioner or teacher model to use the media in learning besides the aspects observed by the teacher's activeness in teaching the media and guiding students during learning. Based on the results of the analysis of the media observation sheet, it is said that it is practically proven that the total average reaches 4.56 or with the results of the percentage reaching 91.2% and categorized as good. Can be seen in Figure 6.

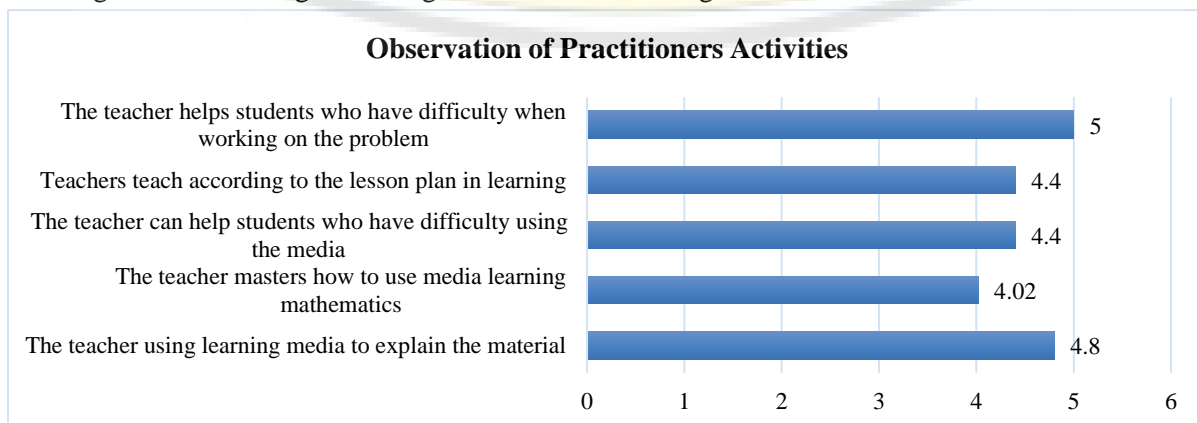


Figure 6. Results of Practitioners Activities Observation

Practical analysis is also supported by interviews with the model teacher. Interviews were conducted after learning using e-comic media using Pixton and Kelase assisted by Geogebra were carried out. Based on the results of interviews during learning practitioners did not experience difficulties in using media, the difficulty experienced by teachers is in controlling students not to open google, youtube and other pages. The use of online media does require a long time at the beginning of the log in but when there is time the practitioner expresses his interest in using similar media. Based on this opinion the teacher is interested in using this media in subsequent learning as an innovation in the use of comics in learning. The short-term development of e-comic by teachers without drawing skills is evidence that Pixton software is able to be used to enrich the learning process with alternative representations [16]. Pixton software is easy to use, and users don't need to design or have comic drawing skills [29].

3.3. Analysis of Media Effectiveness

The effectiveness test was carried out to find out how effective the e-comic media was using Pixton and Kelase assisted by Geogebra that had been developed. Data analyzed include cognitive, psychomotor, and affective aspects. Cognitive aspects were obtained through learning outcomes tests where there were 10 questions tested after students carried out e-comic media learning using Pixton and Kelase assisted by Geogebra. Tests are carried out online. Based on the test results, it was found that the percentage of students who scored above KKM was 75% and categorized as good. Using the cartoon concept can have a positive impact on scientific learning and technology education which is explored besides the cartoon-based learning concept influences student learning achievement in a positive direction [30]. Integration of comic maker software such as Toondoo results in higher academic performance compared to traditional teaching [15]. The results obtained by students can be seen in Figure 7.

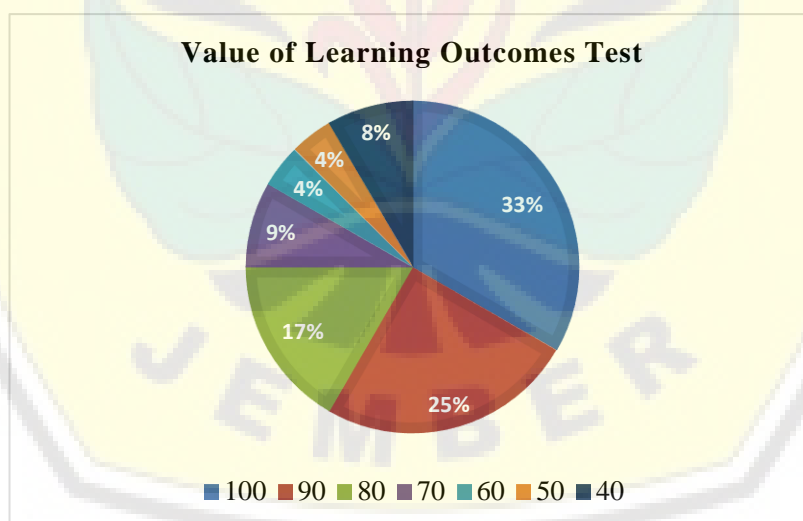


Figure 7. Value of Learning Outcomes Test

The second aspect, psychomotor, was obtained through observation sheets on students, where on the observation sheet the aspects assessed included students' skills in using the media during learning and activeness during the teaching and learning activities. Observer who conducted observation of 5 observers. Based on the results of the analysis of psychomotor aspects, the total average is 4.35 with a percentage of 87% or categorized as good. The last aspect is affective obtained through student questionnaires, based on the results of the total average reaching 1.88 with a percentage of 93.75% and categorized as good. The results of observations and student questionnaires can be seen in Figure 8 and Figure 9.

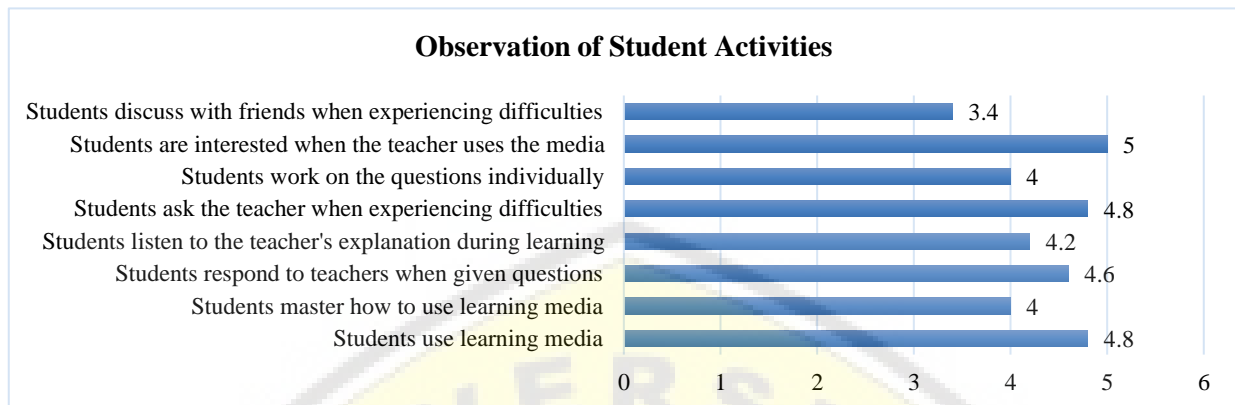


Figure 8. Results of Student Activities Observation

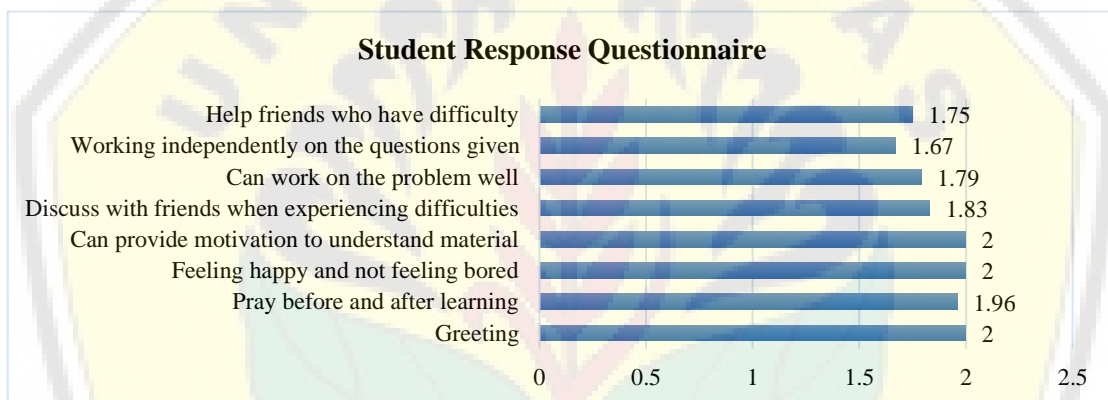


Figure 9. Results of Student Response Questionnaire

Effectiveness analysis was also supported by interview data on three students who obtained low, medium, and high test scores. Based on the results of interviews, the three students expressed their interest during the learning they felt happy and not bored with the learning media they could understand the material presented. With the application of computers in teaching mathematics, mathematics learning is considered to be interesting and enjoyable [31]. In accordance with the research entitled "The Role of Social Learning Networks in Mobile Assisted Language Learning: Edmodo as a Case Study" that the students stated the learning done with Edmodo's e-learning assistance was more enjoyable [11]. Nevertheless they had experienced difficulties because they were using the media for the first time. In previous learning they have never used similar media both online and Geogebra so they still need to adapt. Thus teachers are expected to take advantage of technological developments as learning innovations so that they can attract students' attention and improve their abilities and motivate students during learning. This is in line with the research entitled "Evaluating the use of the Too for Collaborative E-Learning of Selected Pre-Service Teachers" which reveals that the use of Toondoo is seen positively by students, because it enhances their communication, creativity skills at the same time improve their academic performance [15].

E-Comic that has been developed in this study has advantages in the use of which users can use learning media anywhere without using print media so that it is more efficient. Users who have joined the class at Kelase can take part in e-comic learning with the supervision of instructors who upload e-comics and can interact in class sessions anywhere. In addition Kelase online class can be used to type mathematical symbols so users do not need to upload images to display mathematical formulas or symbols. Advantages when compared with previous studies can be seen in Table 2.

Table 2. Developed media excellence

No.	Research	Aspect			
		Cartoon Character	Online	Interactive	Input Mathematical Symbols
1.	Development of E-Comic Using Pixton and Kelase Web on Linear Program of Two Variables Assisted by GeoGebra	✓	✓	✓	✓
2.	Septi Adeliyanti (2018) with titled Pengembangan <i>E-Comic</i> Matematika Berbasis Teknologi Sebagai Suplemen Pembelajaran Pada Aplikasi Fungsi Kuadrat	✓	✓	✓	-
3.	Meijayanti dan Sumarno (2016) with titled Pengembangan <i>E-Comic</i> Pembelajaran Berbasis <i>Contextual Teaching And Learning</i> dalam Pembelajaran Matematika Materi Aritmetika Sosial Kelas VII SMP	✓	✓	-	-
4.	Rasiman dan Pramasdyasari (2014) with titled Development of Mathematics Learning Media E-Comic Based on Flip Book Maker to increase the Critical Thinking Skill and Character of Junior High School Students	✓	✓	-	-
5.	Septy, L. dkk (2015) with titled Pengembangan Media Pembelajaran Komik Pada Materi Peluang Kelas VIII	✓	-	-	-
6.	Izza Khoirin Nida, dkk (2017) with titled Pengembangan <i>Comic Math</i> dengan Pendekatan Etnomatematika pada Materi Kubus dan Balok di SMP	✓	-	-	-
7.	Widyastuti, Mardiyana dan Saputro (2017) with titled An Instructional Media Using Comics on the Systems of Linear Equation	✓	-	-	-

4. Conclusion

Based on the results of research and discussion it can be concluded that the learning media produced meet the aspects of validity, practicality and effectiveness. The results of e-comic media validation using Pixton and Kelase in the linear program two variables assisted by Geogebra included in the valid criteria with an average of 4.57 or the correlation coefficient value of 0.91 including the "Very High" category. While the results of the research instrument validation also indicate the category of "Very High" where the average total validation for interview guidelines reaches 4.58 or the correlation coefficient value was 0.92. The average validation of the observation sheet was 4.47 or the correlation coefficient value was 0.89. Whereas the validation of the Learning Implementation Plan (RPP) reaches 4.61 or the correlation coefficient value was 0.92. Based on the results of the trial, the results of media use are included in the level of practicality with the category "Good" with the percentage results reaching 91.2%. Then the effectiveness results of comic media based on cognitive, psychomoto, and affective aspects obtained the level of effectiveness of "Good" in all aspects. Cognitive aspects show a percentage of students who scored above standard value by 75%. The total average on the student observation sheet is 4.35 with a

percentage of 87% in the psychomoto aspect. The last aspect is affective, the results of the average total reached 1.88 with a percentage of 93.75%.

For researchers who develop similar research, difficulties occur at the development stage, namely when the trial is carried out some students pay less attention during the learning process because they use the internet connection to open another page. Developing media should use software that provides all its features for free.

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