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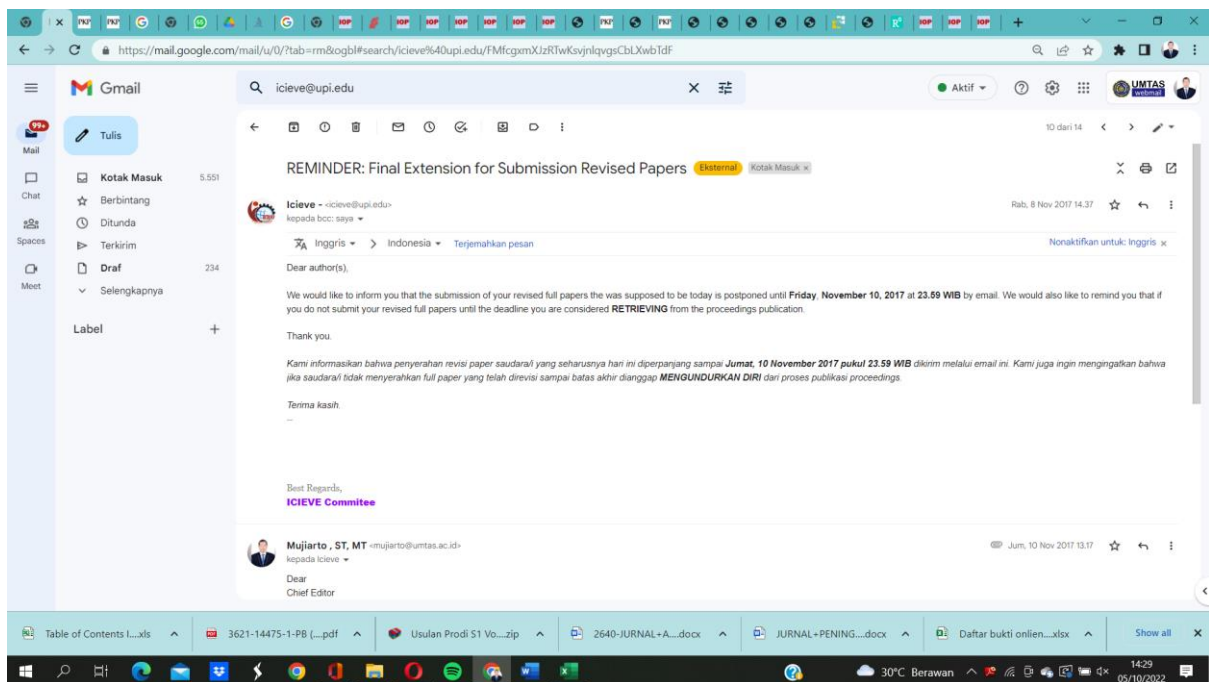
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Screenshot of a Gmail inbox showing an email from the ICIEVE Committee. The email is addressed to Mujarto, ST, MT (mujarto@umtas.ac.id) and is dated June 10, 2017, at 13:17. The subject is "ICIEVE Committee". The body of the email reads: "Dear Chief Editor, Enclosed a final manuscript on conference ICIEVE. Thank you, Best Regard, Mujarto". An attachment titled "E-MMAED_Muja..." is visible. The interface includes a left sidebar with navigation options like "Tulis", "Kotak Masuk", "Berbintang", "Ditunda", "Terkirim", "Draf", and "Selengkapnya". The bottom of the screen shows a Windows taskbar with various application icons and system information like "30°C Berawan" and "14:30 05/10/2022".

Screenshot of a Gmail inbox showing a confirmation email from ICIEVE. The email is addressed to "saya" (me) and is dated November 12, 2017, at 10:54. The subject is "Konfirmasi Pembayaran ICIEVE 2017". The body of the email reads: "Dear Author, Sehubungan dengan berlangsungnya proses layout prosiding paper ICIEVE 2017, Kami ingin menanyakan perihal pembayaran paper atas nama Mujarto, A Djohar, M Komaro yang berjudul A Design of innovative engineering drawing teaching materials to improve vocational high school students competences. Mohon untuk segera konfirmasi pembayaran ke Bu Isma (081320706408) paling lambat hari Senin, 13 November 2017 pukul 12.00 WIB. Terima Kasih. Best Regards, ICIEVE Committee". The interface includes a left sidebar with navigation options like "Tulis", "Kotak Masuk", "Berbintang", "Ditunda", "Terkirim", "Draf", and "Selengkapnya". The bottom of the screen shows a Windows taskbar with various application icons and system information like "30°C Berawan" and "14:33 05/10/2022".

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A Design of innovative engineering drawing teaching materials to improve vocational high school students competences

Mujiarto¹, A Djohar², M Komaro³

¹Department of mechanical engineering, Universitas Muhammadiyah Tasikmalaya

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Abstract. Good teaching is influenced by several things such as effective school leaders and skilled teachers who are able to use information communication technology as a medium of learning. The purpose of this research in general is to develop innovative teaching materials in the form of multimedia animation for engineering drawing in the field of technology and engineering at vocational high school. Research method used research and development (research and development / R & D). The results showed that the E-book Multimedia Animation Engineering Drawing (E-MMAED) is easy to possess and contains complete material. students stated that the use of E-MMAED adds to learning motivation and improves learning outcomes (student competencies). We recommend that teachers apply E-MMAED as a learning medium and create other innovations to improve student competences.

1. Introduction

Education in Indonesia is divided into primary, secondary, and higher education. One of the types of secondary education in Indonesia is vocational high school. Vocational high school is a form of formal education unit that provides vocational education at the level of secondary education as a continuation of education in junior high school/madrasah tsanawiyah (Islamic equivalent) or other equivalent schools. Vocational high school offers many expertise programs. One of the expertise programs offered is mechanical engineering drawing.

Problem encountered in the teaching and learning of the competence standard of drawing in the department of mechanical engineering lies in the lack of teaching materials so that learning objectives are not optimally attained. This is in line with the research results of Soma, Candiasa, & Tegeh (2014), reporting that due to a lack of teaching materials, learning goals have not been achieved according to expectation. Meanwhile, according to the research results of Tirta, Santyasa, and Warpala, the application of inappropriate learning models and the coverage of materials that is not in accordance with the syllabus can result in low student achievement. In addition, the materials for the topic of Basic Networking have not been compiled comprehensively. The learning model implemented especially by vocational teachers is not innovative and more teacher-centered. The facilities in the

forms of computers/laptops owned by students have not been fully optimized to support the learning process.

Teachers play an important role in the attainment of learning objectives, in addition to preparing teaching materials. The role includes being a tutor, mentor, instructor, and motivator who is able to encourage students to increase their knowledge through experience. To be a good teacher, learning facilities are necessary for the ease of learning process. Teachers should develop students' interest and invoke their desire to explore all the knowledge they want to gain in the best possible way (Ahmad, Kamin, and Minghat). One of the best ways is to use the development of information and communication technology (ICT).

The rapid development of ICT is used by various sectors, ultimately in this case education, to facilitate learning. Currently, many multimedia animations are developed to improve student success in learning. Firdania's research showed that the application of Computer-Assisted Instruction (CAI) based on multimedia proved to be appropriate to be a learning medium (Firdania). The multimedia application developed in her study is in the form of names of parts of the human body in 2 languages (bilingual), namely Indonesian and English. The application is intended for young children of 5-6 years to introduce the name of the body parts with the concept of playing while learning. In addition, Situmorang, Sitorus, and Situmorang research results indicated that the development of interactive and innovative multimedia-based chemistry materials for senior high school or its equivalent Islamic school helps students in attaining competence and improving learning outcomes. The finding is in line with Agusta, in which the bilingual website "Close to Radioactivity" as a learning medium is found to be appropriate to be used as a self-learning resource for students of senior high school or its equivalent Islamic school and can improve student learning outcomes.

Furthermore, Chiou, Tien, and Lee's research findings suggested that multimedia animation teaching materials could improve learning achievement, retention, and satisfaction. On a different note, the results of research conducted to employees of an electric company show that training methods based on multimedia animation technology and equipped with computer software and database technology could improve the learning efficiency of the employees and greatly reduce the cost of training (Liao, Liang, and Li). The results of previous research thus suggest that the use of multimedia animation has many advantages compared to conventional learning. These advantages include improving students' achievement, learning satisfaction, and learning autonomy.

The purpose of this research in general is to develop innovative teaching materials in the form of multimedia animation for engineering drawing in the field of technology and engineering at vocational high school.

2. Research Method

The research employed the research and development (R & D) method. Borg and Gall (1983, p. 773) defined R & D in education as "a process used to develop and validate educational product." The product developed in this research is in the form of innovative teaching materials for engineering drawing for vocational high school students of the technology and engineering expertise, mechanical engineering expertise program. The use of R & D method in this research is to create, develop, and implement innovative teaching materials to vocational high school students of the mechanical engineering expertise program.

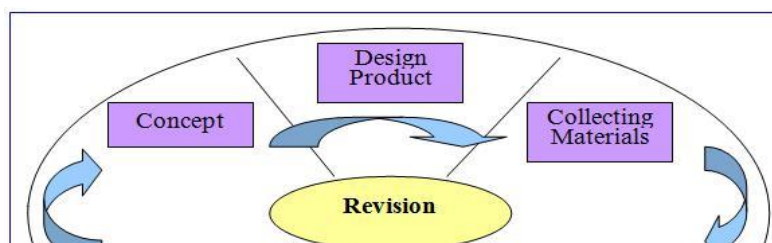


Figure 1. Model Development of E-book based Multimedia Animation Drawing Technique, adopted from Sutopo (2013)

3. Result

Table 1. Results of the test data calculations more widely

Data		score
Pre test	The highest	60
	The lowest	10
	Average	33,00
Post test	The highest	100
	The lowest	51
	Average	80,39
N-gain	The highest	100
	The lowest	34,67
	Average	72,38

From the broader trial it can be seen that the average N-Gain is 72.38 in 100 or at 0.7238. This is evidence that this medium can improve students' ability in high category. The reliability of this media increased from the previous that the category is becoming high-categorized after experiencing the process of repair or development. The process of improvement is done by pay attention student response about the legibility of the media as a result of media testing to the user. In addition, other improvements are also made after considering the test results of media experts to obtain the perfect media according to Media Experts, and Material Experts.



Figure 2. E- MMAED Preview

At the beginning of the opening E-MMAED will appear as shown in Figure 2, which consists of: Syllabus and RPP, Instructions for Use, Play button.

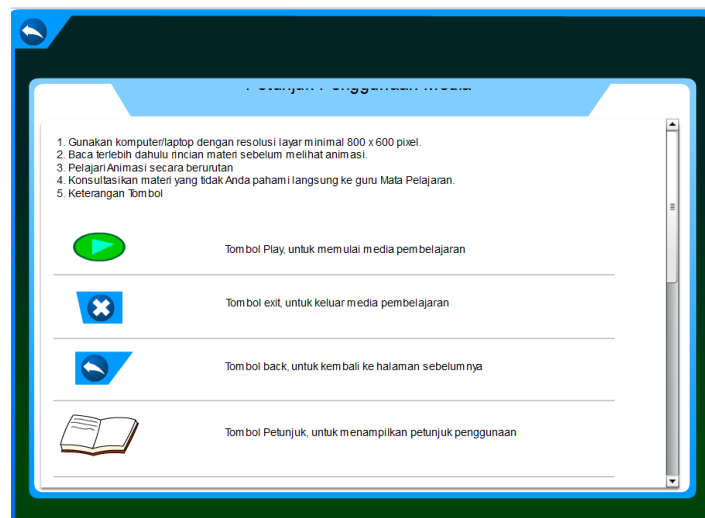


Figure 3. Instructions

Students will start using E-MMAED by clicking on the instructions, as in Figure 3. When students finish reading and understanding the instructions for use, click the "Back" button, to return to the start screen. To start using E-MMAED click the "Play" button.

4. Discussion

Education aims to optimize and develop the ability of learners, especially the intellectual ability. To realize this aim, the assistance in the form of appropriate media is needed. This is in line with Munir's suggestion that media are an integral part of the teaching and learning process in order to achieve the goals of education in general, and the objectives of teaching and learning in schools in particular.

The development of science and technology further encourages renewal efforts in its utilization in the

learning process, which in this case is in the form of media utilization. The media used can be the ones that are already available or developed in accordance with the needs of learning. Teachers are required to be able to use the tools available in the school to meet the expected teaching objectives. In addition, they are required to develop learning media when necessary, so that teachers are required to have sufficient knowledge and understanding of learning media.

Based on the description of learning resources above, especially about learning media, it is important to link learning media to development of learning strategies. It means that learning media are one of the means to make the delivery of teaching materials more effective and efficient. Meanwhile, based on the preliminary study data, the type of media used by the teachers to deliver the materials on engineering drawing in general was textbooks, and the teaching method used in delivering the learning materials was mostly lecturing.

The existing condition discovered from the preliminary study shows a gap between the media required that should be in accordance with the characteristics of the teaching materials and the media that have been used. The finding about inappropriate media used in the schools was evidenced by the students' responses to the clarity of materials delivered by teachers. Some students responded that the materials were not clear. In addition, there is evidence of low learning outcomes in the topic. The results of this preliminary study became the basis for the development of the alternative learning media as well as learning source called Bilingual Multimedia Animation for Engineering Drawing. The characteristics of the e-book based on multimedia animation (Indonesian abbr., E-MMAED) implemented in the field of expertise of technology and engineering in SMK Teknologi YAF Banjar City were formulated based on literature study and research. The main point of the use of E-MMAED on the topic of engineering drawing is that the medium serves as a learning resource and learning medium to improve vocational students' learning outcomes in the forms of conceptual mastery and problem-solving skills.

On the basis of the main point and objectives, then E-MMAED has seven groups of characteristics, as follows: 1) *E-book* characteristics; 2) characteristics of learning resources required based on the preliminary study; 3) characteristics of animation multimedia; 4) characteristics of learning media; 5) characteristics of the required learning media based on the preliminary study; 6) characteristics of the engineering drawing subject; and 7) characteristics of the learning media developed on the basis of indicators.

The e-book based on multimedia animation (E-MMAED) for engineering drawing is created in a Flash format, a format that can integrate images, texts, animations, videos, and sounds. The stages of the making of E-MMAED include material identification and material creation based on several goals or indicators to be achieved.

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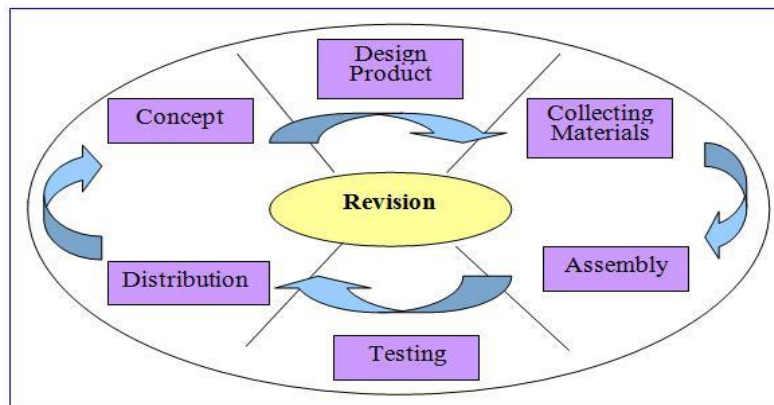


Figure 1. Model Development of E-book based Multimedia Animation Engineering Drawing, adopted from Sutopo (2013)

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This study begins with a preliminary study, e-book design creation, limited testing, expert validation, and extensive trials. the results of extensive trials can be seen in table 1.

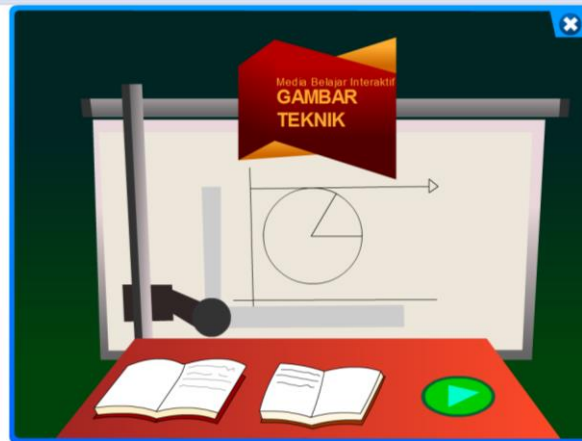
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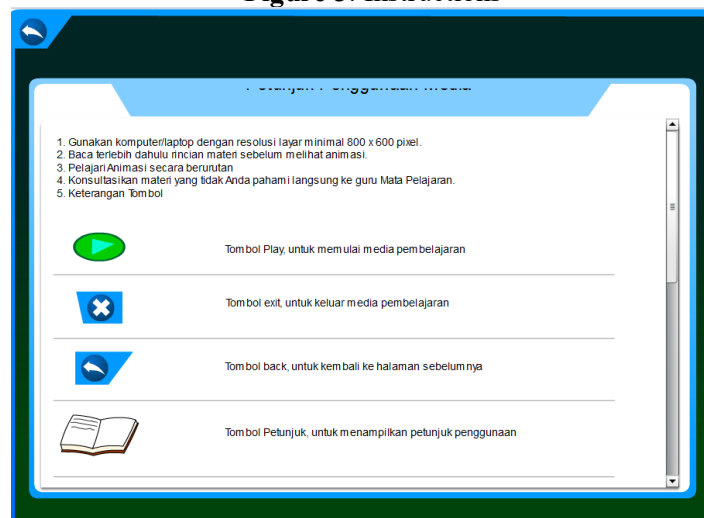
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sufficient knowledge and understanding of learning media.

The rapid development of information technology today has given a new breath toward usage of computer in education. One of the increasingly popular nowadays is a multimedia technology that merges a variety of media such as text, graphics, animation, video and audio controlled by a computer. With this technology, a wide range of multimedia element can be developed to improve the quality of education. In Lin, Shih, and Chang research, interactive multimedia learning system with augmented reality technology can improve the effectiveness and efficiency of teaching and learning behavior. The M.E. et al. study's found that multimedia element for animation video was use significant have capable to increase imagination and visualization of student. The implications of this study provide information of use of multimedia element will student effect imagination and visualization. In general, these findings contribute to the formation of multimedia element of materials appropriate to enhance the quality of learning material for engineering drawing. Based on Daly et al. study results that students are very interested in learning using multimedia because students feel satisfied and learning outcome is achieved. Whereas according to the results of research Lin-li Liu;, Pang;, and Hu, students who use multimedia animation make students feel helpful in learning the practice and innovation in singing.

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Miroslaw Orzechowski

A Design of Innovative Engineering Drawing Teaching Materials

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Abstract. Good teaching is influenced by several things such as effective school leaders and skilled teachers who are able to use information communication technology as a medium of learning. The purpose of this research in general is to develop innovative teaching materials in the form of multimedia animation for engineering drawing in the field of technology and engineering at vocational high school. Research method used research and development (research and development / R & D). The results showed that the E-book Multimedia Animation Engineering Drawing (E-MMAED) is easy to possess and contains complete material. Students stated that the use of E-MMAED adds to learning motivation and improves learning outcomes (student competencies). We recommend that teachers apply E-MMAED as a learning medium and create other innovations to improve student competences.

1. Introduction

Education in Indonesia is divided into primary, secondary, and higher education. One of the types of secondary education in Indonesia is vocational high school. Vocational high school is a form of formal education unit that provides vocational education at the level of secondary education as a continuation of education in junior high school/madrasah tsanawiyah (Islamic equivalent) or other equivalent schools. Vocational high school offers many expertise programs. One of the expertise programs offered is mechanical engineering drawing.

Problem encountered in the teaching and learning of the competence standard of drawing in the department of mechanical engineering lies in the lack of teaching materials so that learning objectives are not optimally attained. Due to a lack of teaching materials, learning goals have not been achieved according to expectation [1]. Meanwhile, the application of inappropriate learning models and the coverage of materials that is not in accordance with the syllabus can result in low student achievement [2]. In addition, the materials for the topic of Basic Networking have not been compiled comprehensively. The learning model implemented especially by vocational teachers is not innovative and more teacher-centered. The facilities in the forms of computers/laptops owned by students have not been fully optimized to support the learning process.

Teachers play an important role in the attainment of learning objectives, in addition to preparing teaching materials. The role includes being a tutor, mentor, instructor, and motivator who is able to encourage students to increase their knowledge through experience. To be a good teacher, learning facilities are necessary for the ease of learning process. Teachers should develop students' interest and



invoke their desire to explore all the knowledge they want to gain in the best possible way [3]. One of the best ways is to use the development of information and communication technology (ICT).

The rapid development of ICT is used by various sectors, ultimately in this case education, to facilitate learning. Currently, many multimedia animations are developed to improve student success in learning. The application of Computer-Assisted Instruction (CAI) based on multimedia proved to be appropriate to be a learning medium [4]. The multimedia application developed in her study is in the form of names of parts of the human body in 2 languages (bilingual), namely Indonesian and English. The application is intended for young children of 5-6 years to introduce the name of the body parts with the concept of playing while learning. The development of interactive and innovative multimedia-based chemistry materials for senior high school or its equivalent Islamic school helps students in attaining competence and improving learning outcomes [5]. The bilingual website "Close to Radioactivity" as a learning medium is found to be appropriate to be used as a self-learning resource for students of senior high school or its equivalent Islamic school and can improve student learning outcomes [6].

Furthermore, multimedia animation teaching materials could improve learning achievement, retention, and satisfaction [7]. On a different note, the results of research conducted to employees of an electric company show that training methods based on multimedia animation technology and equipped with computer software and database technology could improve the learning efficiency of the employees and greatly reduce the cost of training [8]. The results of previous research thus suggest that the use of multimedia animation has many advantages compared to conventional learning. These advantages include improving students' achievement, learning satisfaction, and learning autonomy.

The purpose of this research in general is to develop innovative teaching materials in the form of multimedia animation for engineering drawing in the field of technology and engineering at vocational high school.

2. Methods

The research employed the research and development (R & D) method. R & D in education as a process used to develop and validate educational product [9]. The product developed in this research is in the form of innovative teaching materials for engineering drawing for vocational high school students of the technology and engineering expertise, mechanical engineering expertise program. The use of R & D method in this research is to create, develop, and implement innovative teaching materials to vocational high school students of the mechanical engineering expertise program (see in figure 1)

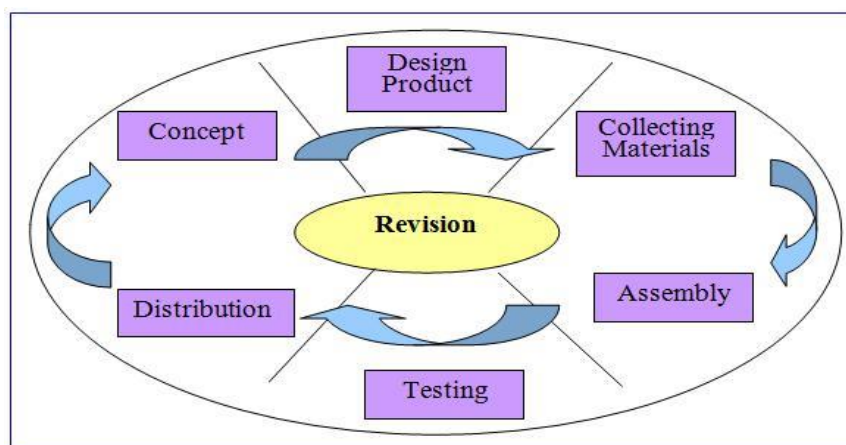


Figure 1. Model development of E-book based multimedia animation engineering drawing.

3. Results and Discussion

This study begins with a preliminary study, e-book design creation, limited testing, expert validation, and extensive trials. the results of extensive trials can be seen in table 1.

Table 1. Results of the test data calculations more widely.

Data	score	
Pre test	The highest	60
	The lowest	10
	Average	33,00
Post test	The highest	100
	The lowest	51
	Average	80,39
N-gain	The highest	100
	The lowest	34,67
	Average	72,38

From the broader trial it can be seen that the average N-Gain is 72.38 in 100 or at 0.7238. This is evidence that this medium can improve students' ability in high category. The reliability of this media increased from the previous that the category is becoming high-categorized after experiencing the process of repair or development. The process of improvement is done by pay attention student response about the legibility of the media as a result of media testing to the user. In addition, other improvements are also made after considering the test results of media experts to obtain the perfect media according to Media Experts, and Material Experts.

At the beginning of the opening E-MMAED will appear as shown in Figure 2, which consists of: Syllabus and RPP, Instructions for Use, Play button.



Figure 2. E- MMAED preview.

Students will start using E-MMAED by clicking on the instructions, as in Figure 3. When students finish reading and understanding the instructions for use, click the "Back" button, to return to the start screen. To start using E-MMAED click the "Play" button.

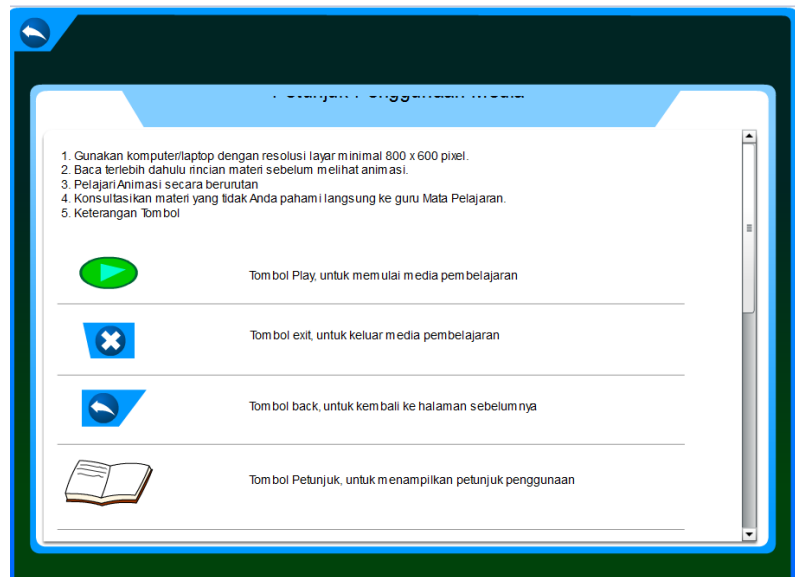


Figure 3. Instructions.

Education aims to optimize and develop the ability of learners, especially the intellectual ability. To realize this aim, the assistance in the form of appropriate media is needed. Media are an integral part of the teaching and learning process in order to achieve the goals of education in general, and the objectives of teaching and learning in schools in particular [10].

The development of science and technology further encourages renewal efforts in its utilization in the learning process, which in this case is in the form of media utilization. The media used can be the ones that are already available or developed in accordance with the needs of learning. Teachers are required to be able to use the tools available in the school to meet the expected teaching objectives. In addition, they are required to develop learning media when necessary, so that teachers are required to have sufficient knowledge and understanding of learning media.

The rapid development of information technology today has given a new breath toward usage of computer in education. One of the increasingly popular nowadays is a multimedia technology that merges a variety of media such as text, graphics, animation, video and audio controlled by a computer. With this technology, a wide range of multimedia element can be developed to improve the quality of education. Interactive multimedia learning system with augmented reality technology can improve the effectiveness and efficiency of teaching and learning behavior [11]. Multimedia element for animation video was use significant have capable to increase imagination and visualization of student [12]. The implications of this study provide information of use of multimedia element will student effect imagination and visualization. In general, these findings contribute to the formation of multimedia element of materials appropriate to enhance the quality of learning material for engineering drawing. Students are very interested in learning using multimedia because students feel satisfied and learning outcome is achieved [13]. Students who use multimedia animation make students feel helpful in learning the practice and innovation in singing [14].

Based on the description of learning resources above, especially about learning media, it is important to link learning media to development of learning strategies. It means that learning media are one of the means to make the delivery of teaching materials more effective and efficient. Meanwhile, based on the preliminary study data, the type of media used by the teachers to deliver the materials on engineering drawing in general was textbooks, and the teaching method used in delivering the learning materials was mostly lecturing.

The existing condition discovered from the preliminary study shows a gap between the media required that should be in accordance with the characteristics of the teaching materials and the media that have been used. The finding about inappropriate media used in the schools was evidenced by the

students' responses to the clarity of materials delivered by teachers. Some students responded that the materials were not clear. In addition, there is evidence of low learning outcomes in the topic. The results of this preliminary study became the basis for the development of the alternative learning media as well as learning source called Bilingual Multimedia Animation for Engineering Drawing. The characteristics of the e-book based on multimedia animation (Indonesian abbr., E-MMAED) implemented in the field of expertise of technology and engineering in SMK Teknologi YAF Banjar City were formulated based on literature study and research. The main point of the use of E-MMAED on the topic of engineering drawing is that the medium serves as a learning resource and learning medium to improve vocational students' learning outcomes in the forms of conceptual mastery and problem-solving skills.

4. Conclusions

On the basis of the main point and objectives, then E-MMAED has seven groups of characteristics, as follows: 1) E-book characteristics; 2) characteristics of learning resources required based on the preliminary study; 3) characteristics of animation multimedia; 4) characteristics of learning media; 5) characteristics of the required learning media based on the preliminary study; 6) characteristics of the engineering drawing subject; and 7) characteristics of the learning media developed on the basis of indicators. The E-book based on multimedia animation (E-MMAED) for engineering drawing is created in a Flash format, a format that can integrate images, texts, animations, videos, and sounds. The stages of the making of E-MMAED include material identification and material creation based on several goals or indicators to be achieved.

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