

INTERACTIVE MULTIMEDIA ENGINE MANAGEMENT SYSTEM (EMS) TO IMPROVE PRIOR KNOWLEDGE AND PROBLEMS SOLVING ABILITY

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ABSTRACT

There are three problems in teaching engineering, especially in the field of electricity, those are: (1) students are unable to read electricity wiring; (2) students do not understand the basic concepts of electricity; (3) students do not understand the basic concept of the relationship between the electrical components. The purpose of this article are: (1) to describe multimedia, especially interactive multimedia engine management systems, prior knowledge, problem-solving; (2) to describe the relationship between interactive multimedia and prior knowledge; (3) to describe the relationship between interactive multimedia and problem solving; and (4) to provide the concept of interactive multimedia engine management system. The collection of information in this article uses a literature review or library research. Problem-solving is an attempt to solve problems through high-level thinking (high order thinking). Prior knowledge is the initial knowledge students have when entering topics with the same background. The existence of interactive multimedia or multimedia has a positive impact on prior knowledge. Some interactive multimedia research has a positive impact on the ability of problem-solving.

Keywords: interactive multimedia, prior knowledge, problem-solving

INTRODUCTION

The technician competencies are knowledge of components name, the component function, how the component works, testing the component condition, concluding the component condition, and finally repairing or replacing the component. The process to get competencies must be hierarchical [1]. The multimedia teaches students to think hierarchically. The competencies were obtained through intensive learning. Every cognitive structuring process requires visualization so that it can be recorded effectively in memory in order of meaningful learning.

Based on the author's experience while teaching in the automotive field and the study results of articles and journals found that there are three problems in teaching engineering, especially in the field of electricity, those are: (1) students are unable to read electricity wiring; (2) students do not understand the basic concepts of electricity; (3) students do not understand the basic concept of the relationship between the electrical components [2]. The state of the electrical ability of vocational

education students is categorized low. These problems are caused by the absence of media that helps visualize electrical materials[3]. In the automotive field, electricity and closed component work are abstract. According to Widjanarko et al. [2], the media in schools cannot describe these concepts optimally. The visualization process needs interactive media to trigger students' memory and motivation [4] and to gain meaningful personal experiences. The visualization is obtained through meaningful individual experiences. On the other words, visualization teaching abstract concepts will be easier [5].

The problems above influence the students' competencies, knowledge, and problem-solving abilities [2]. The electrical system knowledge is very necessary when they are involved directly in the automotive field [6]. For example, when the headlight turns off, it cannot immediately be replaced, before the analysis process is carried out. In this case, the analysis process begins with (1) examination of the fuses; (2) inspection of the lead cable from the fuse to the lamp; (3) inspection of lights; (4) inspection of the conductor from the lamp to the switch; (5) switch inspection; (6) ground check.

Based on the problem and its impact, media, multimedia or interactive multimedia are required in learning to transfer knowledge effectively and meaningfully [2]–[5], [7], [8]. Interactive multimedia are the result of a combination of technology and learning conditions. Interactive multimedia is the best technique in education, because of its ability to show many elements such as sound, images, writing, and animation together [9]. On the other hand, interactive multimedia describes the system at work and describes the conditions that are happening to the existing system in abstract vehicles. The interactive multimedia is to link between practice and theory [6].

The purpose of this article is: (1) to describe multimedia, especially interactive multimedia engine management systems, prior knowledge, problem-solving; (2) to describe the relationship between interactive multimedia and prior knowledge; (3) to describe the relationship between interactive multimedia and problem solving; and (4) to provide the concept of interactive multimedia engine management system.

METHOD

The collection of information in this article uses a literature review or library research, in the research library. The researcher's group articles according to the discussion [10]. The information in articles discusses interactive multimedia, prior knowledge, problem-solving, and the influence of interactive multimedia with prior knowledge and problems solving. More than 84 international journal articles and several books are reviewed with details 36 articles about interactive multimedia, 3 articles about EMS, 5 articles about problem-solving, 8 articles about prior knowledge, 9 articles about relationship interactive multimedia with prior knowledge, 23 articles about interactive multimedia relationships with problem-solving. Based on the literature review, the author discusses providing more in-depth about interactive

multimedia in improving prior knowledge and problem-solving abilities.

RESULTS AND DISCUSSION

In this section, it will be discussed about (1) multimedia, especially interactive multimedia engine management systems, prior knowledge, and problem-solving; (2) the relationship between interactive multimedia and prior knowledge; (3) the relationship between interactive multimedia and problem solving; and (4) the concept of interactive multimedia engine management system.

Multimedia comes from the Latin word and is used to describe how to convey messages and information. Media are commonly related to newspapers, magazines, radio, TV, audio-video programs, computers, etc. [11]. While, Multimedia is a technology that combines print, radio, television, animation, photos and other forms of illustration. The integration of various media enriches the message to be conveyed [12]. Multimedia is the way to reduce cognitive load and reduce the presence of constructional guidance. According to research reports [13], multimedia has provided many benefits including 56% greater learning opportunities, 50 to 60% better learning consistency and 25 to 50% higher content retention. Other studies also explained that the use of multimedia has provided advantages compared with conventional learning (learning without using multimedia) [14]. The type of multimedia that is widely applied by utilizing technology is interactive multimedia.

Interactive multimedia is used to describe fields of scientific research that support expression or communication through various media [15]. The interactive multimedia means that the multimedia used must be able to interact with its users, for example, if a user changes a variable in interactive multimedia then there will be a response [16].

Interactive multimedia in learning can be more effective if it is supported by scientific learning design. Interactive multimedia has long

been used since technology and informatics emerged [17], [18].

Interactive multimedia in learning can be more effective if it is supported by scientific learning design [19], [20]. Interactive multimedia has long been used since technology and informatics emerged [21], [22]. Multimedia assists the quality of learning to be better. Figure 1 presents the interaction between the component of interactive multimedia.

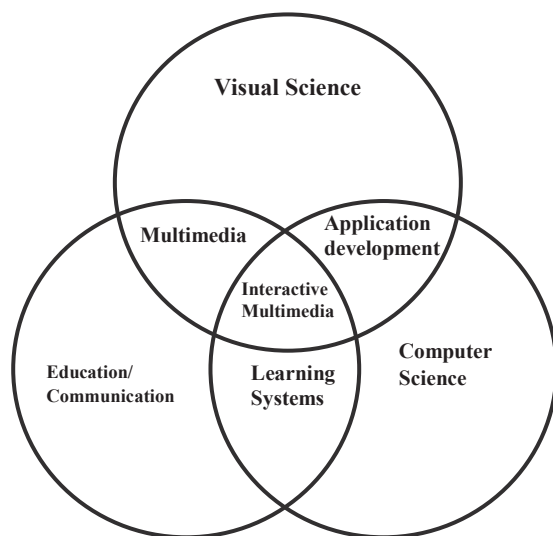


Figure 1. Interaction between Component of Interactive Multimedia

Interactive multimedia is defined as a combination of educational communication, visual science, and computer science. It is the intersection of knowledge areas that enable the creation of communication tools designed to provide information, to educate, to persuade, or to entertain [5]. Learning using multimedia is computer-based learning. [23] and [24] stated that computer-based learning increases the effectiveness of teaching and learning process, in line with research conducted by [25], [26] which states that utilization technology in learning to facilitate the learning process, the use of technology in the learning process can be used in all subject areas such as biology, even in Deniz research the use of technology is used for the history lesson. The use of multimedia technology in any form is an attempt to ease cognitive burdens [27], [28]. Multimedia is the

technology that can be used without looking at the learning model [21], [29]. Learning by using multimedia is a teacher's effort in overcoming students' misunderstanding thus the information explained is related to direct practical activities then the use of multimedia is useful to avoid mistakes [30]. Sitompul & Fadilla [31] state that the use of interactive media in learning will make it easier for students to understand the content of the materials because it helps students to visualize the materials [5], [32].

Multimedia is a medium in raising awareness of students' abilities [33]. Bodemer & Ploetzner [34] suggested the improvement of students' performance and achievement of learning objectives by using interactive multimedia. The application of multimedia provides satisfaction when attending lessons [35], [36]. While Chu et al. [36] explained that the development of multimedia encourages teachers to understand student needs and conditioning the environment or learning situation, in line with Maor [37] who states multimedia to enhance professional thinking, leading, and learning from all aspects of the presented materials. Therefore in designing multimedia, two things need to be considered namely design and pedagogy [38]. Kumpulainen & Salovaara [39] state there are five design principles: guided activities, reflection, feedback, control, and pre-training.

Multimedia is the best media when compared to other media in line with the research of Moreno & Mayer [40] which states that the use of multimedia is better than other media such as power points presentations. Hsiao's research is strengthened by Hsiao et al. [41] who show significant interactions from the media and students' women's questions. Lee & Osman [3] has shown that animation and simulation using information and communication technology (ICT) can help students to visualize and therefore increase their understanding of learning abstract topics.

Zhou & Yadav [42] mentioned that multimedia provides an efficient method for

teaching psychomotor skills to students when entering the workforce. Cavanaugh&Moore[43] research on the use of multimedia in learning increases student independence, maintaining discipline towards goals even without teacher intervention.

Interactive multimedia is expected to help students have basic knowledge or basic concepts in the system [44]. The use of interactive multimedia is expected to reduce cognitive load. The use of technology in learning needs to be considered to obtain an effective and efficient learning process.

In essence, interactive multimedia is a combination of 3 elements of (1) visual science in the form of images, text, videos, images or other visual forms; (2) education and communication can be a model or a way to convey knowledge; and (3) computer science, which is an agent in creating multimedia that

can convey knowledge to students or receivers. Interactive multimedia is a form of multimedia in which users can interact with the multimedia.

The engine management system is the most important part of the EFI system [45]. An engine with an injection system can work properly due to the engine control module. The engine management system has 3 important components, namely sensors, engine control modules, and actuators [45]. Vocational students need to find out how the EMS because they are a candidate technician [46]. The engine management system is the most complex system of the existing system in the car, thus there will very likely be a wrong perception that occurs in the learning process so that the existence of interactive multimedia becomes an urgent need. Figure 2 presents an interactive multimedia engine management system.

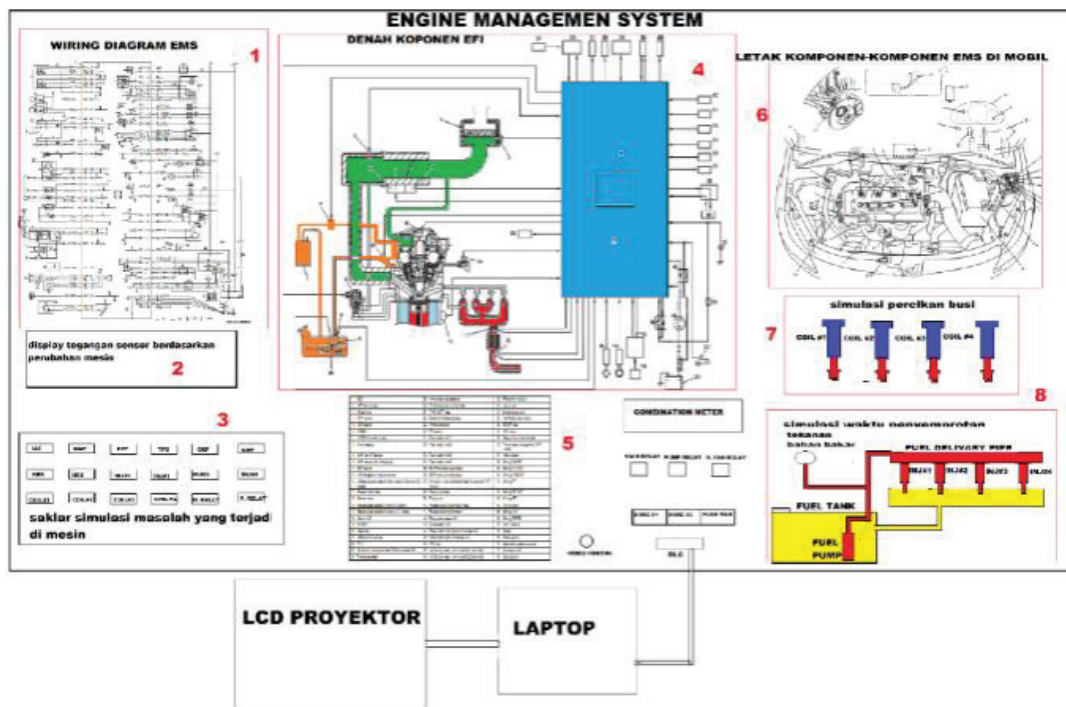


Figure 2. Diagram of Interactive Multimedia Engine Management System

The interactive multimedia engine management system helps students visualize the controlling process of the electronic fuel injection system. The interactive multimedia engine managementsystem includes a wiring image, to provide an overview of the

relationship between the components of the engine management system. Each student is expected to master how to read a wiring diagram as basic knowledge in fixing issues of the engine management system so that students can have the problem-solving ability.

The engine management system must be able to communicate with computers, laptops, and schools, thus students can identify the condition of the engine management system at each change in conditions, such as the injection at 1000 rpm rotation, the amount of air entering, and the ignition time. Figure 3 shows illustrations in achieving goals.

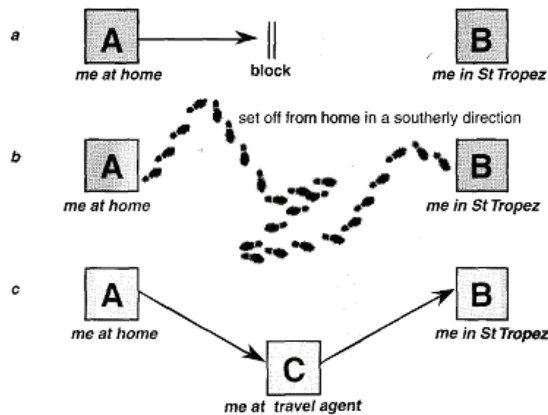


Figure 3 Illustrations in Achieving Goals

Figure 3 illustrates that each goal will have a constraint to realize, the constraint is a problem. Each problem must be solved so that it can achieve the goals that have been designed, each problem is solved in each way depends on each person who solves it. The order of thought patterns in solving problems is called problem-solving [47]. Every problem solving requires knowledge related to the problem to be solved. Problem-solving is the activity which uses high order thinking [48].

The stages of problem-solving are divided into four stages: (a) understanding the problem, (b) making a plan, (c) carrying out the plan, and (d) looking back. According to Wallas in Oliver [49] the stages of problem-solving include: (a) preparation, (b) incubation, (c) lighting, and (d) verification. In the preparation stage, researchers gather information about the problem. At the incubation stage, researchers set aside the problem of doing other activities. In the lighting stage, researchers find the key to the solution. At the verification stage, the solver checks the solution.

Problem-solving is a cognitive process, which implies conscious thinking. Educators must find the best strategy for teaching problem-solving skills. Therefore, successful instructors teach problem-solving, motivate students, and involve them to be more involved in finding accurate solutions. Various researchers agree that teaching problem solving is more efficient than traditional methods because it can produce better retention skills in the long run, and can develop critical thinking skills [50], [51]. In essence, problem-solving is an attempt to solve problems through high-level thinking (high order thinking). In the process of problem-solving required mastery of the problem.

Prior knowledge is defined variously by experts. Prior knowledge is the students' initial knowledge before entering a relevant learning environment for gaining new knowledge [52]. Prior knowledge is the overall knowledge of a person, including explicit knowledge, conceptual knowledge, and metacognitive. Prior knowledge can be expressed as knowledge possessed by students, both subject knowledge, strategic knowledge, and personal knowledge when learning new materials [53].

Prior knowledge in the form of an overall acquisition of knowledge, attitudes, and skills that students get as a result of learning activities before following the next learning process [36]. Prior knowledge is influenced by two factors, internal and external [54]. Prior knowledge influences learning activities [55]. The influence of prior knowledge includes: (1) giving effect to students when receiving new information; (2) influences the ability to organize new knowledge or information; (3) influences the ability to connect new information; (4) influences the effectiveness of the learning process [56].

Prior knowledge is very important in learning activities, to prevent misinterpretation. Strengthening Prior knowledge is very necessary. False interpretations often occur in learning that may be one of the causes is Prior knowledge [53]. For example, learning

electricity in vocational schools will be effective if the basics of electronics have been optimally mastered. Often students are confused when finding a fundamental problem.

Conceptual change is the process of transition from the usual way of observing, directing attention, conceptualizing, reasoning, and justifying. Students slowly transform previous knowledge to accommodate new scientific ideas. Prior knowledge tends to be a conceptual form that forms the foundation for new knowledge. Cognitive psychology and the organization of knowledge that arises through a variety of experiences and developments cause prior knowledge to be applied as a whole to improve individual abilities in certain fields [57].

In essence, prior knowledge is the initial knowledge possessed by students when entering a topic with the same background. The prior knowledge can affect the results of the learning process and it is important to avoid misperceptions about new knowledge. It is the initial scheme in shaping new knowledge.

In Song's research, Schroeder & Cenkci[58] state that the use of multimedia has a direct impact on prior knowledge. Multimedia can help improve the quality of prior knowledge. In the study, Song et al. [59] obtained significant prior knowledge differences between the experimental class and the control class. The ability of prior knowledge is an important component in learning that must be improved through the use of multimedia [60], [61]. Each student has different abilities despite using multimedia [62]. Rias [63] states that the provision of comprehensive information has an impact on the ability of comprehensive prior knowledge as well. Learning activities are knowledge transfer processes, there needs to be a minimum of capital that students must have, namely prior knowledge. Amadiou et al. [64] suggest that prior knowledge influences computer-based learning. Multimedia is used in building prior knowledge in course places [65].

In essence, multimedia is a way of presenting information or knowledge for students in the learning process. Many studies concluded that interactive multimedia or multimedia has a positive impact on prior knowledge. This happens because by using multimedia, the information delivered is more comprehensive.

The use of computer-based multimedia influences knowledge and problem-solving abilities [66], [67] In line with Sazali et al.[68] who states that the problem-solving ability of students increases when using video media during learning. By using multimedia, students' visualization of events or phenomena presented by multimedia will be formed in the brain. As stated by Mannheim & Amy[69] that using multimedia helps students to visualize phenomena. Hoffman & Ritchie[70] state the use of multimedia in problem-based learning can help students solve problems. The development of problem-solving skills is done by designing problem-based learning. Problem-based learning or better known as problem-based learning (PBL) will be effective in achieving its objectives by utilizing multimedia [71]. In a study by Liu et al. [54] conveying that by using multimedia will be presented comprehensive instructions to guarantee the achievement of educational goals. In solving problems, comprehensive information is required so that the problem-solving process can be done precisely and quickly. Multimedia which is the result of the use of computer technology has an impact on the data presented to be comprehensive.

The application of multimedia in the learning process can improve problem-solving skills [72]–[74] with multimedia students can pay attention to the causal relationship of system components. Students who have problem-solving abilities then students have critical thinking, creativity, teamwork and presentation skills. Quality education is measured from student learning outcomes, one component of learning outcomes is problem-solving, self-efficacy [75].

Ryan et al. [76] illustrate that there is a strong relationship between interactive multimedia and the ability to understand problem-solving instructions, interactive multimedia is designed by integrating computer technology so that instructions will be more quickly understood. The use of interactive multimedia or interactive media in learning has several benefits, among others: (1) Interactive multimedia provides influence in the effectiveness of learning [77]; (2) the use of interactive media can minimize manufacturing errors [26]; (3) the use of interactive multimedia increases the competence of students [78]; (4) by using interactive multimedia maintaining student motivation [15]; (6) utilization of interactive media in learning encourages active students [79]; (7) interactive media can bridge basic concepts into real knowledge; (8) interactive media increases student satisfaction with learning [77]; (9) the use of multimedia for education has the advantage of providing instructions in the learning process; 10) through the use of multimedia students can visualize the process that they will do [80].

The existence of interactive multimedia is not only beneficial for students but also useful for teachers, with the presence of interactive multimedia encourages teachers to always be creative in changing teaching methods to improve student achievement [26]. Interactive media makes it easy to teach basic concepts [81]. Interactive media existence in learning has an important role, so it must be a special concern for teachers and agencies.

In essence, the ability to solve problems is important to be mastered by every student, especially vocational students majoring in automotive because when they work in a workshop they will always be treated to problems every day. Problem-solving skills are not easy to do, need good cognitive abilities. Multimedia that presents comprehensive information is very useful in forming problem-solving patterns. In some interactive

multimedia, research has a positive impact on the ability of problem-solving.

CONCLUSION

Interactive multimedia is a combination of 3 elements, namely: (1) visual science in the form of images, text, videos, images or other visual forms; (2) education and communication can be a model or a way to transfer knowledge; (3) computer science, which is an agent in creating multimedia that can transfer knowledge to students or receivers. Problem-solving is an attempt to solve problems through high-level thinking (high order thinking). Prior knowledge is the initial knowledge students have when entering topics with the same background. The existence of interactive multimedia or multimedia has a positive impact on prior knowledge. some interactive multimedia research has a positive impact on the ability of problem-solving.

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