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E-LEARNING AS A SUPPORTING STUDY IN THE FIELD OF VOCATIONAL AND AUTOMOTIVE ENGINEERING

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ABSTRACT

E-Learning is a computer and network usage that aims to help optimize the learning process for user performance improvements. Today's technological advances encourage every field that provides learning and training processes to use e-learning. But vocational education of the automotive field has different learning model characters with other fields. Vocational education in the automotive field not only form knowledge but also aspects of applied skills to help users become a mechanic. Therefore, it is necessary to review the e-learning impact literature on achieving the cognitive and psychomotor of users. This is done to be developed as an optimal e-learning model, especially for the automotive field. Systematic Literature Review (SLR) was chosen as a method for reviewing the library of this article. SLR is a method used to combine knowledge to answer research questions. The SLR in its application has several stages that researchers must implement. The stage is 1) determining the research question; 2) The search process of articles; 3) Choose relevant articles; 4) Determine the quality of the article; 5) analyzing the data; 6) determine the research gap. The results of the Literature review showed that the majority of articles showed a positive impact on the use of e-learning to increase cognitive aspects. However, it increasingly shows that psychomotor accomplishments with e-learning are not as easy as cognitive accomplishments. A psychomotor achievement is very limited if it relies solely on the use of e-learning, as it requires hands-on experience. The objective of automotive competence in the field of vocational is to be able to work on repairs, maintenance, and maintenance of cars periodically. Therefore, the need to develop e-learning designs that support the minds of the experience process collaborates with hands-on experience. The design of e-learning for the vocational field of the practice must be more structured, easy to use, attractive and appropriate to the real job

INTRODUCTION

The 4.0 Industrial revolution is characterized by the passing of each field to a digitizing model, along with the advancement of communication technology. The 4.0 Industrial Revolution has an interconnect design through the Internet of People (IoP), information transparency, technical assistance, decentralized decisions (Herman, Pentek, & Otto, 2015). The influence of the era of the 4.0 Industrial Revolution in education is the rise of technology use by learners as a learning medium. Sadikin (2019) stated that learners in the era of the 4.0 Industrial Revolution must possess information and communication skills (ICT Literacy). This means that the 4.0 industrial Revolution forms a change in the new learners' character from the previous era.

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Learners in the era of the 4.0 Industrial Revolution are better known as the term Z generation. Generation Z is a child born in the 1990s and grew up in the 2000s (Tulgan, 2013). The trend of the Z-generation child one is the rise of social media usage because generation Z tends to interact with others (Tulgan, 2013). The social media-editing tool is one of them is a smartphone. Therefore Ozkan (Ozkan & Solmaz, 2015) reveals that the Z-generation considers the use of smartphones to be an important part of his life.

The use of smartphones at all times affects achieving learning achievements. Kates (Kates, Wu, & Coryn, 2018) stated that there was an impact on the use of smartphones that were negatively affected by the performance of the smartphone, but when the integration of smartphones as a learning medium, there was a possibility of canceling the negative impact. Indirectly means teachers are required to control and optimize the integration of smartphones in the educational world. Valdivia (Valdivia & Nussbaum, 2007) states that the use of mobile learning can improve the interaction between students, learning and effective work activities.

E-Learning models are a solution for optimizing current learning. Although the development of e-learning requires a large fee for the provision of Web servers and technical support, but the cost is cheaper than the provision of class facilities and the provision of teachers (Ghirardini, 2011). E-Learning models in this era proved to be widely used in various countries of the world. Arkorful (2015) stated in his research that the integration of e-learning in college has been implemented globally.

The rise of e-learning models in the education world expanded to the application of vocational and technical areas. Vocational education in Indonesia is an education that prepares the mastery of certain skill competencies on the graduates to be ready to work (Triyono, 2015). Education that serves to prepare graduates to be ready to work has a different character. Triyono (2015) said that the model of e-learning design in vocational education should be able to guide students in applying theories to their appropriate practices. Further research on the instructional design of e-learning in each vocational and technical skills competency needs to be implemented.

One of the competences of vocational education expertise in Indonesia is the competency of automotive expertise. The implementation of e-learning in the automotive field today has also been widely developed. It is evident from the many articles that research the use of e-learning in the automotive field. Evaluation results of the use of e-learning automotive industry Training (Bogdan & Ancusa, 2016). A three-step method for the development of e-learning with video demonstrations, real experimentation, and computer simulations (Chowdhury, Alam, & Mustary, 2019). Integration of Video on YouTube with Google e-learning on the competency of automotive engineering skills (Prastiyo, Djohar, & Purnawan, 2018). Usability, ease, and impact of positive attitudes on the use of e-learning in the automotive industry (Karaali, Gumussoy, & Calisir, 2011).

However, vocational education students of automotive engineering in Indonesia can be said to be competent when able to meet the competency aspects of the graduates that have been established. The competency aspect of automotive engineering graduates includes aspects of spiritual attitude, social attitudes, knowledge, and skills. Therefore, this article will be reviewing the impact of e-learning in automotive techniques on achieving the knowledge aspects (cognitive) and the skills (psychomotor) of the user.

RESEARCH METHODS

Systematic Literature Review (SLR) was chosen as a method for reviewing the library of this article. This article will be reviewing the literature related to the implementation of e-learning in automotive engineering. The purpose of the Literature review is to dig further the impact of e-learning on the achievement of cognitive and psychomotor users. SLR is a method used to combine knowledge to answer research questions (Kitchenham et al., 2009). The SLR in its application has several stages that researchers must implement.

Research questions

Research questions are used to maintain the reviewer's focus (Wahono, 2015). The research questions that will be discussed on this literature review are:

a. How is the use of e-learning in the automotive field to achieve the cognitive sphere?
b. How is the use of e-learning in the automotive field against the production of psychomotor domains?

Search process

The process of searching the article by referring to the title, keyword, abstract. The article search is limited to six scientific databases such as Emerald, Science Direct, Sage Journal, Eric, Elsevier, and Tylor & Francis. The year of publication of articles between 2015 to 2020. The year restriction is done to obtain the latest research results.

The initial keyword used to search for an article is e-learning. The use of e-learning keywords brings up 536,078 articles of total hits from six bases. Emerald 36,000 article, Science Direct 135,108 article, Sage Journal 119,430 article, Eric 8897article, Elsevier 336 article, and Tylor & Francis 236,307 article.

The keywords are then converted into e-learning in the automotive so that the articles are more relevant to the research question. The use of these keywords brings out a total of 8,301 hits from six bases. Emerald 92 article,

Science Direct 3,756 article, Sage Journal 1365 article, Eric 1 article, Elsevier 302 article, and Tylor & Francis 2785 article.

Relevant Articles

The articles are selected articles that are relevant and able to be material answers to the research questions that have been determined. The selection of articles can be based on authenticity, not duplicates, and suitability of researched topics. At this stage, the selection of articles is more detailed by looking at the contents of the article.

Total articles obtained from six bases with e-learning keywords in automotive reached 8,301 articles. However, it still should be done further selection, because there are still many articles that are irrelevant to be selected as a literature review.

The selection of the article by looking at the title of the article is very close to relation to the implementation of e-learning in the field of automotive. Finally, a filtered article from six scientific databases is 10 articles. Emerald 2 article, Sage Journal 0 article, Science Direct 6 article, Eric 1 article, Taylor & Francis 1st article. But out of 10 articles are filtered, there are only 3 relevant articles.

The addition of literature is done by expanding the keywords into e-learning, vocational education, and engineering. The year limitation is also added to the length that the article is between 2000 and 2020. The results found an additional 27 additional articles divided into 11 e-Learning articles in the field of automotive, 10 engineering e-Learning articles, and 6 e-learning articles in the field of Vocational Education Training (VET).

Quality Assessment

27 articles that will be made in the literature review consist of 24 international articles and 3 national articles. However, to improve the ease of access to literature, the literature review was conducted on international articles. The articles are divided into two types i.e. 14 journal articles and 10 article proceedings.

Table 1. Articles reviewed

Author	Journals/Proceedings	Title
Janus S Liang	Journal of Network and Computer Applications	The troubleshooting task implementation in automotive chassis using virtual interactive technique and knowledge-based approach
Jean Jacques Chanaron	International Journal of Automotive Technology and Management	SMEs' requirements and needs for e-learning: a survey in the European automotive industry
Ordaz, N et al	Procedia Computer Science	Serious Games and Virtual Simulator for Automotive Manufacturing Education & Training
Calisir, Fethi et al.	Journal of Human Factors and Ergonomics in Manufacturing & Service Industries	Predicting the Intention to Use a Web-Based Learning System: Perceived Content Quality, Anxiety, Perceived System Quality, Image, and the Technology Acceptance Model
Karaali, Demet et al.	Journal of Computers in Human Behavior	Factors affecting the intention to use a web-based learning system among blue-collar workers in the automotive industry
Jean-Jacques Chanaron, Grenoble	International Journal of Automotive Technology and Management	Evaluating e-learning among automotive Small-Medium Suppliers (1) Developing an evaluation tool kit
Willy Prastiyo, As'ari Djohar, Purnawan	Jurnal Pendidikan Vokasi	Development of YouTube integrated google classroom-based e-learning media for the light-weight vehicle engineering vocational high school
Ed Rhodes, Ruth Carter	Journal of Workplace Learning	Collaborative learning in advanced supply systems: The KLASS pilot project
Razvan Bogdan, Versavia Ancusa	World Journal on Educational Technology	Developing e-learning solutions in the automotive industry

Author	Journals/Proceedings	Title
Andrea Beinicke, Eva Kyndt	Journal of Studies in Continuing Education	Evidence-based actions for maximizing training effectiveness in corporate E-learning and classroom training
A Hutanu, Gabriela et al.	Procedia - Social and Behavioral Sciences	Contemporaneous Issues in e-Learning Projects of the European Union
Müller, Eduard et al.	Procedia - Social and Behavioral Sciences	New Concept in e-learning Materials Based on Practical Projects
Böhner, Johannes et al.	Procedia CIRP	Developing a learning factory to increase resource efficiency in composite manufacturing processes
Martin, Juhas et al.	CSIT 2018 Proceedings	Augmented reality in education 4.0
Chowdhury Harun et al.	Energy Procedia	Development of an innovative technique for teaching and learning of laboratory experiments for engineering courses
Apse et al.	IEEE Global Engineering Education Conference	Practically oriented e-learning workshop for knowledge improvement in engineering education computer control of electrical technology
Santoso, Harry B. et al.	Proceedings - 2014 3rd International Conf. on User Science and Engineering: Experience. Engineer.	Research-in-progress: User experience evaluation of Student-Centered E-Learning Environment for computer science program
Inayat, Irum et al.	Journal of Computers and Education	Effects of Collaborative Web-Based Vocational Education and Training (VET) on Learning Outcomes
Huang, Shi Ming et al.	International Journal of Innovation and Learning	An empirical investigation of learners' acceptance of e-learning for public unemployment vocational training
Mukhanov, Bakhyt et al.	Procedia Computer Science	A model of virtual training application for simulation of technological processes
Nafukho, Fredrick et al.	European Journal of Training and Development	Predicting workplace transfer of learning: A study of adult learners enrolled in a continuing professional education training program
Triyono, M. Bruri	Procedia - Social and Behavioral Sciences	The Indicators of Instructional Design for E-learning in Indonesian Vocational High Schools
Stiller, Klaus D. et al.	European Journal of Open, Distance, and e-Learning	Learner Attrition in An Advanced Vocational Online Training: The Role OF Computer Attitude, Computer Anxiety, And Online Learning Experience
Gutiérrez, Isabel. et al	International Journal of Information and Education Technology	Learning e-Learning Skills for Vocational Training Using e-Learning: The Experience Piloting the (e)VET2EDU Project Course

RESULTS AND DISCUSSION

E-Learning is an Internet and computer utilization to improve learning and performance (Ghirardini, 2011). The significance of learning and performance enhancement makes e-learning not only balanced on public education but also in other areas. E-Learning needs in the automotive industry/workplace engineering to improve the performance and knowledge of employees has been discussed in various articles (Chanaron, 2002)(Ordaz, Romero, Gorecky, & Siller, 2015)(Calisir, Gumussoy, Bayraktaroglu, & Karaali, 2014). E-learning is also used in technical studies in colleges (Martin, Bohuslava, & Igor, 2018)(Apse-Apsitis, Avotins, Krievs, & Ribickis, 2012)(Santoso, Isal,

Basaruddin, Sadira, & Schrepp, 2015). Besides, vocational Education Training also uses e-learning as a learning supplement (Inayat, Amin, Inayat, & Salim, 2013).

Motive of the use of e-learning in automotive, engineering, vocations so many, one of them to save training costs (Bogdan & Ancusa, 2016). Besides, e-learning can also be a solution to the simplicity and availability of tools (Martin et al., 2018). E-Learning is needed in modeling training for material saving (Johansson, Larsson, & Tatipala, 2017). The flexibility of learning time and to increase learning time is also a reason for the use of e-learning (Apse-Apsitis et al., 2012). The use of e-learning is also intended for students to become active in learning (Santoso et al., 2015). Advantages on distance aspects are also gained with the use of e-learning (Inayat et al., 2013).

Research results on e-learning implementation indicate that there is a positive impact on the optimization of industrial learning and the automotive vocational education. But the positive impact of the e-learning still needs to be examined in more depth to the achievement of learning objectives in the realm of cognitive and psychomotor.

Achievement of cognitive sphere of E-Learning use

Training in the automotive industry includes many things that can be divided into technical and non-technical to improve industrial productivity. E-Learning allows users to learn non-technical fields, such as understanding of the company's internal knowledge and the work environment virtually. A study showed that employee understanding of the company's network supply increased after using e-learning (Rhodes & Carter, 2003). E-Learning can also be deployed to study the production process in the automotive industry (Ordaz et al., 2015). E-Learning users can feel the problems and dangers that are approaching their original situation in the workplace (Mukhanov et al., 2015).

Employee understanding in a technical field can also be improved. E-Learning to support technical fields in the form of virtual Interactive. The results of the study showed that using virtual interactive can improve the knowledge of a technician on how to troubleshoot chassis case in automotive (Liang, 2008). Network collaboration training from the automotive and aircraft industry supplier can also use e-learning (Rhodes & Carter, 2003). Training in the automotive engineering industry in modeling, where the accuracy of size tolerance is needed, so the use of e-learning is required (Johansson et al., 2017). It can also improve employee understanding of the process of the Pleiadeans without having to act on a real system and without stopping the workflow (Mukhanov et al., 2015). This is because e-learning provides a simulation similar to the real condition (Ordaz et al., 2015). In this context industry managers can encourage workers to use e-learning to increase their knowledge.

Vocational education students who use e-learning learning also have a significant increase in knowledge (Prastiyo et al., 2018). For example the addition of knowledge about parts and problems in CAR chassis (Liang, 2008). Material learning materials on automotive parts (Böhner, Weeber, Kuebler, & Steinhilper, 2015). Increased popularity and effectiveness of learning in industrial automation subjects (Martin et al., 2018). Improved learning comprehension on programming, CAD, and web design lessons (Inayat et al., 2013).

The use of e-learning in the CFD practice courses in the engineering department of a college shows that e-learning is complementary (Chowdhury et al., 2019). The cognitive aspects achieved with video content on e-learning such as basic understanding of laboratory equipment, real-life work in the laboratory, know the experimental procedures and instruments. Cognitive aspects are also accomplished with the content of simulated forms on e-learning. Increased understanding of experimental work, additional knowledge of tools, and knowledge of experimental parameters.

User knowledge can be obtained by working on the provided quiz-quiz. The Quiz is available when the concept of the theory is presented, as well as at each end of learning as an assessment (Bogdan & Ancusa, 2016). This increased understanding can also be gained by collaborating with each other's knowledge in collaboration between e-learning users (Rhodes & Carter, 2003). Knowledge enhancement is also gained by combining the use of e-learning with modules (Gutiérrez, Sánchez, Castañeda, & Prendes, 2017).

The collaboration with the use of modules is supported with a task-based learning model. The purpose of task-based learning to trigger self-learning skills (Gutiérrez et al., 2017). The example of e-learning is VETeL e-Course, where the training process lasts for 60 days consisting of 10 modules (Gutiérrez et al., 2017). VETeL e-Course users who can pass through the course well obtain satisfactory cognitive results. Among them knowledge about e-learning science, e-activities design, science, and e-learning content.

Mental e-Learning users are involved to coordinate an option, the concept of choice, and to take some action so that the cognitive aspect can be achieved (Chanaron, 2006). Mental use of such e-learning can be improved by presenting useful content for users (Calisir et al., 2014). More details are e-learning content in the form of training programs that are directly related to real work or content that can support the job (Nafukho, Alfred, Chakraborty, Johnson, & Cherrstrom, 2017). Therefore, experience and persistence of users is also an influence on the success of e-learning learning in the achievement of knowledge (Stiller & Köster, 2016). This is evidenced in the results of the e-learning learning study using VETeL e-Course (Gutiérrez et al., 2017). But doing so does not mean that e-learning can substitute for hands-on learning (Chowdhury et al., 2019).

Achievement of the Psychometric sphere of E-Learning

The achievement of the psychomotor sphere of E-Learning the Achievement of a psychomotor sphere with the increase of hands-on experience in e-learning is still developed because it must be suited with the actual state with the characters in the company (Bogdan & Ancusa, 2016). E-learning empowerment to improve the hand-on experience with game-shaped learning design.

E-Learning designed as a game makes it easy for students to understand a process and what is related to measuring a manufacturing material design (Böhner et al., 2015). Students also gained an increased understanding of the design of injection machinery after using e-learning in the course of CAD Modeling. E-Learning in the form of games also offers a collaborative learning experience (Inayat et al., 2013). This experience became valuable to students for designing with materials based on real projects. So that students can understand a learning problem more easily and faster (Müller, Grach, & Bezděková, 2015).

Skills can be optimized using an e-learning collaboration on a course, with the provision of instructional content designs for students and instructors (Inayat et al., 2013). The application of e-learning as a tool to achieve psychomotor aspects needs to be done gradually, starting with the development of a practical model, physical artifacts/evidence, and reusable object of doctrine (Huang, Wei, Yu, & Kuo, 2006).

The achievement of the psychomotor aspect of e-learning is derived from the achievement of cognitive aspects. E-Learning users can apply their knowledge after understanding the contents of the available modules, so the design step is done by the user. The result of the psychomotor aspect of the concept of knowledge is produced (Gutiérrez et al., 2017).

Psychomotor achievements can be seen as impacts such as increased skills in work. Work skill enhancement indicators can be seen from several variables such as work autonomy, the variability of work, and working complexity (Nafukho et al., 2017). For example, in the results of the training on e-learning use to study e-learning science, the user must have skills as a facilitator on the e-learning he made (Gutiérrez et al., 2017). In addition to the more practical things such as an automotive mechanic, the indicator of psychomotor achievement of e-learning is measured from the skills of the use of tools or performance (Triyono, 2015).

Gap Analysis

The majority of articles show the positive impact of e-learning using the enhancement of cognitive or knowledge aspects. Many aspects of knowledge are obtained in technical and non-technical sciences. Cognitive accession is found in the form of knowledge in some areas of automotive such as material science, problems, production processes. Improvement of cognitive enhancement is also known in the training organized by the automotive industry to educate employees. Increased cognitive achievement the use of e-learning is also gained in addition to automotive fields such as programming, web design, CAD design, CFD, e-learning courses, industrial automation. This means that any use of e-learning will have a positive impact on cognitive accomplishments.

However, it increasingly shows that psychomotor accomplishments with e-learning are not as easy as cognitive accomplishments. It is evident from the many articles describing the impact of psychomotor achievement after explicitly using e-learning. The lack of impact of the e-learning impacts provides a clue that psychomotor pensions are derivatives of cognitive achievement. This means that a new psychomotor is acquired when cognitive aspects are well achieved.

A psychomotor achievement is very limited if it relies solely on the use of e-learning, as it requires hands-on experience. The exception is the field that does use a computer in its workmanship such as CAD modeling, web design, programming, PHP, media content creation.

Characteristics for a practical vocational field require a more structured e-learning concept and implemented on real usability. The vocational field prepares students to be ready to work, hence the need for achievement can be aimed at Bloom's taxonomy theory. The Bloom's taxonomy theory includes achieving the affective, cognitive and psychomotor spheres.

Automotive is a part of engineering technology, including engineering and vocational fields. Automotive Engineering has a specific qualification standard so that someone is said to be competent in this field. The objective of automotive competence in the field of vocational is to be able to work on repairs, maintenance, and maintenance of cars periodically. So, in the field of automotive vocational and similar in need of learning in the form of direct practice on the object, different from the field of vocational which is simulative.

Therefore, the need to develop e-learning designs that support the minds of the experience process has collaborated with hands-on experience. The design of e-learning for the vocational field of the practice must be more structured, easy to use, attractive and appropriate to the real job. The implementation of e-learning in real conditions cannot be separated by traditional face-to-life learning with collaborative learning models and performance evaluations.

CONCLUSION

The development of the 4.0 industrial era supports innovation in vocational education learning. The use of e-learning as an effort to optimize the achievement of learning objectives. E-Learning is an Internet and computer utilization to improve learning and performance (Ghirardini, 2011). So, with the use of e-learning contains several advantages such as more cost-effective, flexibility of time, flexibility of distance learning, increased knowledge, learning activity, learning modernists, ease in repeated learning.

E-Learning is a supplement or complementary vocational education learning process. The learning characters in vocational education not only achieve cognitive accomplishments but also affective and psychomotor. Vocational education learning models are not only minds on experience but also hands-on experience. The learning Model of e-learning is needed in the vocational field of automotive and the like. This is because automotive vocational education is an education that prepares students to be ready to work as a reliable mechanic.

Increased achievement by using e-learning can be divided into achievements in cognitive and psychomotor aspects. Achievement of cognitive aspect in the form of increased understanding and knowledge of a concept or learning material. The increase in psychomotor aspects is indicative of improved performance, efficacy, and productivity. Psychomotor achievement is the result of achieving cognitive aspects.

Therefore, the need to develop an e-learning design that supports minds-on and hands-on experience. So that future research results can support e-learning design for improvement of automotive vocational education competence and others.

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