

Literature Study: The Need for a Virtual Reality-Based Learning Model in Automotive Learning

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Abstract. The development of virtual reality has penetrated into the realm of education. Learning media that previously utilize videos, flash animations, and textbooks, now can be modified to be more realistic in the virtual reality space. Theory learning that requires system understanding ability and imagination of motion as in the field of automotive engineering education will be facilitated if these media are applied. Technology will make student learning process to be easier, however based on the study results there are conditions where the media that has been made by the developer has not been implemented properly, some contributing factors lie in inaccurate learning delivery, unclear and unstructured implementation of the model, and poor ability of virtual reality media users. This research using Literature Study method with the analytical steps carried out in this study were: (1) reading abstracts; (2) analysing; (3) recording important information; (4) conducting discussion; and (5)) providing conclusions. The results of the study indicate that a learning model is needed as a structured guideline in implementing virtual reality-based learning which consists of: (1) syntax of model; (2) learning approach; (2) implementation strategy; (3) criteria for required virtual reality media; (4) assessment techniques; (5) and benefits of model application.

Keywords: Virtual Learning Model, Virtual Reality, Automotive

1 Introduction

The vision of improving the prosperity achievement using technology has been carried out in various parts of the world for the last few years. Europe with its Industry 4.0, Japan with its Society 5.0, Industrial Internet in America, Made in China 2025 in China, and Smart City in Asia. They are competing to create public welfare by utilizing technological developments [1]. The impact of these developments is the occurrence of various things in the life system that are difficult to predict. In social life, new terms and habits have also emerged. The use of social media on the internet, which was previously limited to uploading news and commenting on it, is now growing towards virtual reality. Virtual Reality is a technology that allows users to experience situation as if it were reality while they only use computer technology [2]. The development of virtual reality is currently entering the realm of education. Education and

learning media that previously utilize videos, flash animations, and textbooks, now can be modified to be more realistic [3].

Theory learning that requires system understanding ability and imagination of motion as in the field of Automotive Engineering will be facilitated if these media are applied [4]. Student learning process will be easier with the help of technology; it also stimulates students' cognitive development [5]. However, under certain conditions, many media that have been created by developers have not been implemented properly, one of the factors is the delivery of learning that is not conducted properly [6]. The problem that needs to be solved in this phenomenon is concerning the implementation model of virtual reality-based learning. The model includes steps, implementation methods, approaches, strategies, virtual reality media criteria for required, assessment techniques, and the benefits of using the model. This model can later become guidance for the implementation of virtual reality-based learning.

1.1 Assumptions of Needs

Study on the need for virtual reality-based learning models is very much necessary, especially in the area of automotive. This assumption is motivated by the information technology development in various aspects of life, one of which is in the field of education. It is also the case in automotive engineering education in which learning characteristics in the cognitive domain are leaning towards an understanding of mechanics, therefore real illustrations are desired. This study needs to be conducted in dealing with the development of education in digitalization era. Developments in social media such as Facebook which will soon move into Metaverse world indirectly invite the world of education to immediately improve its quality, especially on its learning media [7]. Another necessary measure in the world of education is to develop a virtual reality-based learning model. Because in the implementation of virtual learning media, several constraints were encountered in technical implementation of learning. The model will be useful as a guideline in implementing virtual reality-based learning and can support learning in metaverse world.

The distinctiveness of this analysis lies in its learning model development while previous studies were focusing on media development. Therefore this study will assist academic personnel and support educational progress in implementing virtual reality-based learning, especially in automotive engineering learning. This assumption needs to be supported by literature study results on the need for a Virtual Reality-based learning model in Automotive Engineering learning. This model will be useful in implementing theoretical learning about understanding concepts and mechanisms of a system.

2 Research Methods

This study was conducted using the Literature Study method. Literature study is a series of activities in the context of gathering literature, reading, taking notes, and processing research materials [8]. This study was conducted by collecting literature from books, textbooks, journals, scientific articles, and literature reviews, related to virtual learning models, virtual reality, and automotive learning media. The data was then analysed as a basis to determine the need for a virtual reality-based learning model.

The analytical steps carried out in this study were: (1) reading abstracts from previous studies related to virtual learning models, virtual reality, and automotive learning media (11 Article);

(2) analysing and providing an assessment of whether the research results are linear with the research objectives; (3) recording important information in each literature reviewed; (4) conducting discussion on the observed important information related to virtual learning models, virtual reality, and automotive learning media; (5) providing conclusions about the need for a Virtual Reality-based learning model in Automotive Engineering learning.

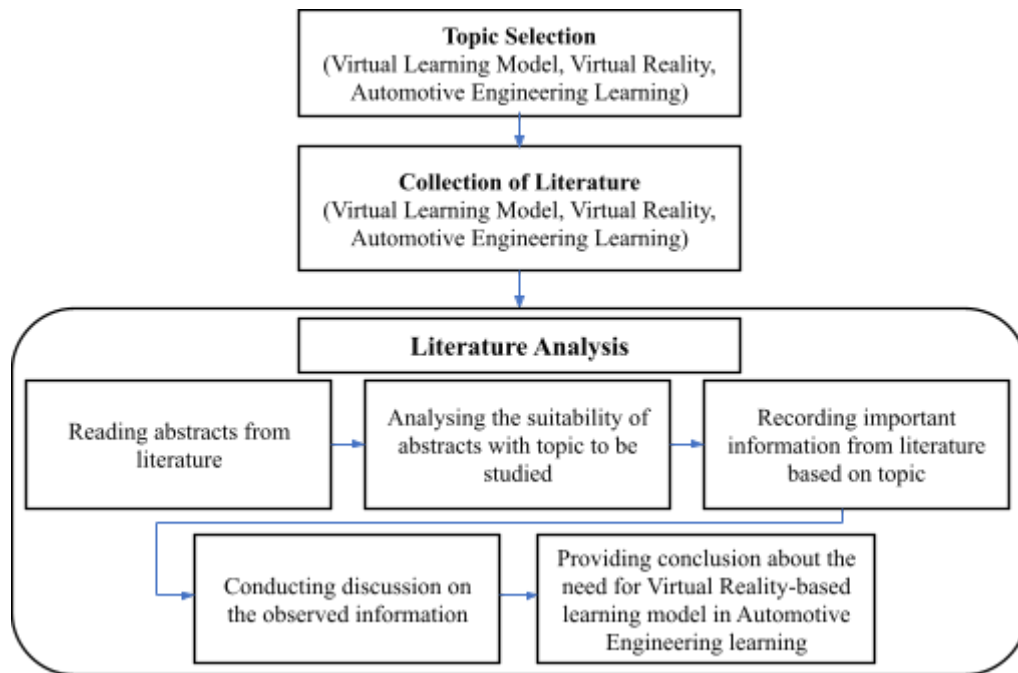


Figure 1. Flow of the Literature Study Implementation

3 Results and Discussion

3.1 Results

The world today is competing to achieve technology-oriented vision of prosperity. This is reflected in the development of various aspects of life, one of which is in the field of education. Many academic researchers are conducting research on industry 4.0 to adapt to the needs of outputs in the field of education, especially in manufacture and smart products [9]. Industry 4.0 was originally a vision of the future described in the German government's high-tech strategy which was designed based on information and communication technologies such as Cyber-Physical Systems, Internet of Things, Physical Internet, and Internet of Services to achieve a high degree of flexibility. One of the important tasks in the preparation of Industry 4.0 is the adjustment of universities to the demands of this vision, especially in engineering department [10]. In line with Germany in Europe, there is Society 5.0 in Japan as the fifth stage of its vision in developing a new human-centered society [11]. Industry 4.0 and

Society 5.0 also demand educational entities to focus on digitalization, particularly in the area of internet, practicality, and artificial intelligence. Learning in digital era is also required to be more student-centered and teacher-centered, by applying appropriate and collaborative learning models [12]. The same thing happened in China who borrowed the German concept of Industry 4.0 and the Industrial Internet which was formulated in the United States. China developed a strategy of promoting and deploying smart manufacturing technologies through the vision of Made in China 2025 [13]. With this vision, education policy in China has shifted to education that is oriented towards high technology and entrepreneurship [14]. Education 4.0 will be an aspect of curriculum development in the future. Teachers must be competent to build students' skills in facing a competitive and innovative working world after the industrial revolution 4.0 [15]. The development of technology for education in Indonesia is also experiencing improvement. The Covid-19 pandemic and the *Merdeka Belajar - Kampus Merdeka* policy seem to stimulate the world of education to be more dynamic and growing along with technological developments. *Merdeka Belajar* is a form of learning aiming to create an innovative and non-restrictive learning culture in accordance with the needs of students [16]. Covid-19 has indirectly brought the world of education towards digitalization, because learning must be carried out remotely or utilizes digitalization [17].

The digital transformation that occurs in the world of education leads to the development trends of Audio Visual Media, Learning Management System, Augmented Reality, Virtual Reality, and Mixed Reality. These trends have resulted in policies focusing on anticipation of skills needs and deskilling, allowing old skills to be replaced with new skills. From several aspects of these development trends, Virtual Reality has become a trend that is widely used in learning [18]. Virtual Reality is a computer technology to create an interactive 3D world; it can be used as a student learning media to improve knowledge and practical skills [19]. Problems that arise in implementing virtual reality are not only in terms of technology or media, but also in terms of users and the process of implementing virtual reality media. The analysis of determining the research topic is taken from the following state of the art:

Table 1. Literature Analysis

No	Literature Title	Topic Suitability	Year	Analysis of Findings / Important Information
1	Development of a Virtual Learning Model to Increase Learning Effectiveness at State Madrasah in Parepare [20].	√	2014	The learning effectiveness can be improved through the application of virtual learning models. It would be better if the learning is based on virtual reality.
2	Development of Virtual Learning Model (MPV) Based on Video E-Learning Moodle [21].	√	2019	This learning model is quite effective when compared to conventional learning methods. After its application was tested, there were differences in learning outcomes. The learning outcomes of students who received material using the video e-learning method were better when compared to students who received conventional material.

No	Literature Title	Topic Suitability	Year	Analysis of Findings / Important Information
3	Pengembangan Desain Model Pembelajaran <i>Virtual Flipped Classroom</i> . [22].	√	2020	The design of the virtual learning using flipped classroom model is better than the one using classical classroom model.
4	<i>Flipped Classroom Virtual Learning Model Design Development</i> [23].	√	2021	Self-directed learning and communication are soft skills aspects that are very urgent for students to have in order to achieve success in virtual learning.
5	<i>The application of virtual reality technologies in engineering education for the automotive industry</i> [24].	√	2015	Virtual Reality has been proven to improve the quality of Automotive Engineering training.
6	<i>Teaching-learning process through VR applied to automotive engineering</i> [25].	√	2017	The use of virtual laboratory in automotive field showed positive results. Virtual reality is considered very versatile, can be accommodated and extended to other fields
7	<i>Multi-user industrial training and education environment</i> [26].	√	2018	Virtual reality allows students in automotive field to gain skills and build habits. The implementation constraints lie on the suitability of implementation, steps and learning strategies.
8	<i>Virtual reality simulations in nurse education: A systematic mapping review</i> [27].	√	2021	Despite being advanced, Virtual Reality still has its drawbacks. Virtual Reality developers should consider including psychomotor skills at equipment usage and social interactions.
9	The effect of using virtual reality media with classical learning models on student learning outcomes at the TK Negeri Pembina Singaraja [28].	√	2018	One of the constraints in virtual reality implementation lies in the learning implementation. Further study is expected to pay attention to classroom conditioning as best as possible.
10	Virtual Reality in Initial Teacher Education (VRITE): a reverse mentoring model of professional learning for learning leaders [29].	√	2022	Online learning is recognized as an effective teaching method and tool, widely integrated into different teaching and learning strategies to provide quality education at different levels. However, there has been no extensive research on online learning, delivery, and learning assessment.
11	The Sustainability of a Community of Inquiry in Online Course Satisfaction in Virtual Learning Environments in Higher Education [30].	√	2022	There are cases of dissatisfaction towards virtual learning environment, due to its poor interaction between instructors and students related to content. Community of inquiry in online learning has a significant influence on student satisfaction in learning activities.

3.2 Discussion

Indonesia is ready to follow the era of society 5.0 such as the use of virtual reality, augmented reality and artificial intelligence. But what needs to be watched out for is an increase in infrastructure, preparation of human resources and aligning education with industry. The results of the analysis indicate a room for new educational study in the virtual reality world, particularly for researchers in the field of education development, specifically in the scope of reality-based learning model development. The review results of several previous studies specify that the learning effectiveness can be improved through the application of virtual learning models; however it would be better if the learning process was carried out using virtual reality. This is because virtual reality will make the display of illustrations in learning to be more realistic. It is recommended to implement virtual learning media using flipped classroom model rather than classical classroom model. If students are being active in doing assignments, the learning objectives will be more likely to be achieved. It is also recommended that the flipped classroom being used is equipped with an investigative approach, so that students can practice case-based learning. In implementing virtual learning, the self-directed learning component also needs to be considered to improve students' concentration in learning.

It is proven that virtual reality can improve the training quality in automotive sector. The implementation of a virtual laboratory using virtual reality has a positive impact. This happens because students in the automotive sector gain skills and build habits in using media. The constraints lie in the steps and learning strategies. The results of the study also indicate that Virtual reality still has weaknesses. Developers also need to consider the user's motoric skills. Students need to get training on how to use equipment before virtual reality-based learning can be conducted. Further study is expected to pay attention to classroom conditioning as best as possible because there has not been extensive research outside the media, especially in online learning, delivery and learning assessment. These problems are examples of dissatisfaction cases with the virtual learning environment due to its poor interaction between instructors and students related to content being taught.

There is room for improvement and study on the development of virtual reality-based learning models in the automotive engineering field is very much needed. This virtual learning model that has been developed provides empirical information in the implementation of virtual reality-based learning models. So that the use of virtual learning media can be more aligned and in accordance with user needs. The requirements that need to be improved in virtual reality-based learning include: (1) Syntax; (2) Method; (3) Approach; (4) Strategy; (5) Criteria for required virtual reality media; (6) assessment technique; and (7) the benefits of using virtual reality-based learning models.

4 Conclusions

Finding of this research is virtual reality-based learning model is very much needed however there several constraints in implementation virtual reality-based learning media including: (1) systematic steps for learning implementation; (2) not yet focusing on the flipped classroom; (3) lack of attention in self-directed learning; and (4) the need for user's motoric development, especially in automotive competencies. So, therefore it is necessary to develop a virtual reality-based learning model in automotive engineering competencies that provides information about: (1) Syntax; (2) Method; (3) Approach; (4) Strategy; (5) Criteria for

required virtual reality media; (6) assessment technique; and (7) Benefits of using virtual reality-based learning models.

Acknowledgments. Thank you to the Kemdikbudristek for trusting in the management of Penelitian Dosen Pemula funds to researchers with the title Development of Virtual Reality-Based Virtual Learning Models on Automotive Engineering Competence with Research Contract Number 158/E5/PG.02.00.PT/2022.

References

- [1] Fukuyama, M. (2018). Society 5.0: Aiming for a new human-centered society. *Japan Spotlight*, 27(Society 5.0), 47-50.
- [2] Turner, C. J., Hutabarat, W., Oyekan, J., & Tiwari, A. (2016). Discrete event simulation and virtual reality use in industry: new opportunities and future trends. *IEEE Transactions on Human-Machine Systems*, 46(6), 882-894.
- [3] Hussein, M., & Nätterdal, C. (2015). The benefits of virtual reality in education-A comparison Study.
- [4] Makarova, I., Khabibullin, R., Belyaev, E., & Bogateeva, A. (2015, September). The application of virtual reality technologies in engineering education for the automotive industry. In *2015 International Conference on Interactive Collaborative Learning (ICL)* (pp. 536-544). IEEE.
- [5] Fuady, R., & Mutalib, A. A. (2018). Audio-visual media in learning. *Journal of K6 Education and Management*, 1(2), 1-6.
- [6] Zhang, L., Bowman, D. A., & Jones, C. N. (2019, September). Exploring effects of interactivity on learning with interactive storytelling in immersive virtual reality. In *2019 11th International Conference on Virtual Worlds and Games for Serious Applications (VS-Games)* (pp. 1-8). IEEE.
- [7] Preston, J. (2021). Facebook, the metaverse and the monetisation of higher education. *Impact of Social Sciences Blog*.
- [8] Zed, Mestika. 2008. *Metode Penelitian Kepustakaan*. Jakarta: Yayasan Obor Indonesia
- [9] Oztemel, E., & Gursev, S. (2020). Literature review of Industry 4.0 and related technologies. *Journal of Intelligent Manufacturing*, 31(1), 127-182.
- [10] Coşkun, S., Kayıkçı, Y., & Gençay, E. (2019). Adapting engineering education to industry 4.0 vision. *Technologies*, 7(1), 10.
- [11] Fukuda, K. (2020). Science, technology and innovation ecosystem transformation toward society 5.0. *International journal of production economics*, 220, 107460.
- [12] Sudibjo, N., Idawati, L., & Harsanti, H. R. (2019). Characteristics of Learning in the Era of Industry 4.0 and Society 5.0. *Advances in Social Science, Education and Humanities Research*, 372(1), 276-278.
- [13] Wübbecke, J., Meissner, M., Zenglein, M. J., Ives, J., & Conrad, B. (2016). Made in China 2025. *Mercator Institute for China Studies. Papers on China*, 2, 74.
- [14] Cunningham, J. A., & Menter, M. (2021). Transformative change in higher education: Entrepreneurial universities and high-technology entrepreneurship. *Industry and Innovation*, 28(3), 343-364.
- [15] Noh, S. C., Karim, A., & Malek, A. (2021). Design Thinking Mindset to Enhance Education 4.0 Competitiveness in Malaysia. *International Journal of Evaluation and Research in Education*, 10(2), 494-501.
- [16] Anonymous. 2020. *Buku Panduan Merdeka Belajar-Kampus Merdeka*. Jakarta: Direktorat Jendral Pendidikan Tinggi Kemendikbud RI.
- [17] Abidah, A., Hidaayatullaah, H.N., Simamora, R.M., Fehabutar, D. and Mutakinati, L., 2020. The Impact of Covid-19 to Indonesian Education and Its Relation to the Philosophy of "Merdeka Belajar". *Studies in Philosophy of Science and Education*, 1(1), pp.38-49.
- [18] UNESCO-UNEVOC International Centre. (2020). Trends in New Qualifications and Competencies for TVET Perspectives of the European UNEVOC Network. UNESCO-UNEVOC. https://unevoc.unesco.org/pub/bilt_trends_mapping_study.pdf
- [19] Rachmatullah, R. (2020). Efektivitas Penggunaan Virtual Reality (VR) Dalam Pendidikan Keperawatan: Literature Review. *Jurnal Kesehatan*, 9(2), 11-21.
- [20] Said, H. (2014). Pengembangan Model Pembelajaran Virtual Untuk Meningkatkan Efektivitas Pembelajaran Pada Madrasah Negeri Di Kota Parepare. *Lentera Pendidikan: Jurnal Ilmu Tarbiyah dan Keguruan*, 17(1), 18-33.

- [21] Afriansyah, H. (2019). Pengembangan Model Pembelajaran Virtual (MPV) Berbasis Video E-Learning Moodle. *Bahana Manajemen Pendidikan*, 8(1), 1-7
- [22] Mariyana, R. (2020). Pengembangan Desain Model Pembelajaran Virtual Flipped Classroom. *Jurnal Pembelajaran Inovatif*, 3(2), 150-156.
- [23] Ariwibowo, B., Prasetyani, H., Atika, A., & Marlis, A. (2021). Urgensi self-directed learning dan komunikasi peserta didik pada virtual based learning. *Jurnal Taman Vokasi*, 9(2), 133-139.
- [24] Makarova, I., Khabibullin, R., Belyaev, E., & Bogateeva, A. (2015, September). The application of virtual reality technologies in engineering education for the automotive industry. In *2015 International Conference on Interactive Collaborative Learning (ICL)* (pp. 536-544). IEEE.
- [25] Ortiz, J. S., Sánchez, J. S., Velasco, P. M., Sánchez, C. R., Quevedo, W. X., Zambrano, V. D., ... & Andaluz, V. H. (2017, December). Teaching-learning process through VR applied to automotive engineering. In *Proceedings of the 2017 9th international conference on education technology and computers* (pp. 36-40).
- [26] Andaluz, V. H., Sánchez, J. S., Sánchez, C. R., Quevedo, W. X., Varela, J., Morales, J. L., & Cuzco, G. (2018, June). Multi-user industrial training and education environment. In *International Conference on Augmented Reality, Virtual Reality and Computer Graphics* (pp. 533-546). Springer, Cham.
- [27] Plotzky, C., Lindwedel, U., Sorber, M., Loessl, B., König, P., Kunze, C., ... & Meng, M. (2021). Virtual reality simulations in nurse education: A systematic mapping review. *Nurse education today*, 101, 104868.
- [28] Dharma, K. Y., Sugihartini, N., & Arthana, I. K. R. (2018). Pengaruh penggunaan media virtual reality dengan model pembelajaran klasikal terhadap hasil belajar siswa di TK Negeri Pembina Singaraja. *Jurnal Pendidikan Teknologi dan Kejuruan*, 15(2).
- [29] Farrell, R., Cowan, P., Brown, M., Roulston, S., Taggart, S., Donlon, E., & Baldwin, M. (2022). Virtual Reality in Initial Teacher Education (VRITE): a reverse mentoring model of professional learning for learning leaders. *Irish Educational Studies*, 41(1), 245-256.
- [30] Nasir, M. K. M., & Ngah, A. H. (2022). The Sustainability of a Community of Inquiry in Online Course Satisfaction in Virtual Learning Environments in Higher Education. *Sustainability*, 14(15), 9633.
- [31] Nastiti, F. E., & Ni'mal'Abdu, A. R. (2020). Kesiapan pendidikan Indonesia menghadapi era society 5.0. *Jurnal Kajian Teknologi Pendidikan*, 5(1), 61-66.