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The Application of Virtual Reality (VR) in Vocational Education:

A Systematic Review

Amin*, Isma Widiaty, Cica Yulia, Ade Gafar Abdullah
Universitas Pendidikan Indonesia
Bandung, Indonesia
*amin@upi.edu

***Abstract*—Virtual Reality (VR) technology, has gained popularity in recent years and its efficacy has been proven in different education fields. This technology visualizes abstract concept so it can be intuitive concept to improve the understanding in describing objects. VR stimulates students to develop communication skills and motivates students to develop skills. Research method that is used here is a systematic review with twenty relevant articles. This literature review states that the research before about the use of virtual reality (VR) in skill-based education. In this view, several databases are chosen to collect articles that were published in 2015 to 2020. To fulfill the object of this research, all articles are classified based on analyzed result. That VR can be used in vocation fields such as medical, language, and laboratory practices.**

Keywords—virtual reality, vocational education

I. INTRODUCTION

Education is a field that must be prioritized because students have several potentials. There is a tendency that one better to learn in natural environments. Learning can be meaningful if students experience what they are learning, not just know what they are learning. Learning activity that is oriented to mastering of the learning materials has been proven to give a good result in short-term memory completion but fail to give students the skills to solve problems in long-term life problems and we must approach this problem from different sides, one of this is with technology.

Technology in education field has quickly developed, the need of technology in this globalization age is undeniable. The development of educational institution can be measured on how that school uses Communication and Information Technology as it is needed and the institution optimization of that technology.

The use of technology in education includes of how the use of gadgets and sometimes lacks integrated technology in education. That means one needs knowledge and understanding of technology.

Knowledge and experience are important in teaching process. That means, the newest trend in learning is based on experience, that is to use Virtual Reality that gives student possibility to experience the reality [1].

Virtual Reality (VR) Technology has gain popularity in recent years and its efficacy has been proven in different educational environments [2]. Virtual reality (VR) is the most recent technology, popular and fastest growing because it is considered as the efficient and different technics to give detailed exploration in virtual world [3]. Virtual Reality (VR) is innovative technology to create three dimensional environments and is an interactive technology. Virtual Reality gives possibility for someone to do a simulation the real object with the use of computer that fan generate three-dimensional situation and gives a user an almost real situation and the user physically involves in that experience. This system can be used by architect, medical worker, even the layman to involves in near real situations. This technology visualizes abstract concept intuitively to enhance the understanding in describing objects. VR stimulates students to develop communication skills and motivates students to develop skill [4]. There are four advantages in applying virtual technology in skill-based education [5] that is 1). Mining the school's potential resource, 2). Construction daily training base, 3). Construction digital campus, 4). Developing virtual teaching. So as in the process of applying virtual reality in education can be more effective and efficient.

VR technology is useful to deliver educational contents clearly and to introduce information and communication technology to learning, experiment, and practical training. VR technology is helpful to adapt the virtual content so it can follow the development of equipment. Students can use VR to master the knowledge and skill. Learning process is optimized and learning quality is improved [5].

The next discussion is arranged as follows. First, theoretical framework from this study by giving short description about Virtual Reality (VR). Second, what methodology that is used by researchers in this research about the use of Virtual Reality

(VR)? That question is answered based on result and method of research before this research.

II. Theoretical Framework

A. Virtual Reality

Virtual Reality (VR) is an innovative technology to create three-dimensional, interactive reality. Virtual Reality is a technology that enables someone to do simulation on the real object by using computer that can generate three dimensions situation so as the user can physically involve. This system can be used by architect, medical worker, even layman to do activities that simulate real world. This technology can visualize abstract concept to be more intuitively to enhance understanding in describing an object. VR stimulates student to develop communication skills and motivates student to actively develop his/her skills [4].

There are four applications of virtual technology in skill-based education [5] those are:

1) Mining the school's potential resource: Importing VR technology improves vocational education environment, improves the amount of total students, and more students can be enrolled into vocational schools.

2) Construction daily training base: Multimedia technology, combination of hardware-in-loop simulation and virtual reality are utilized to build a virtual modern training base. The "equipment" or "parts" are mainly "virtual". What's more, "virtual" equipments can be upgraded according to the development of real equipments.

3) Construction digital campus: VR technology is connected with ultra-high speed data transmission, mass data storage, distributed and parallel data processing. Applying VR technology accelerates the information construction of vocational school.

4) Developing virtual teaching: The classroom expands to invisible teaching space as virtual classroom and virtual school. VR technology can be used as removable distance learning e-learning site. Distant education is based on interactive distance learning course catalogs and websites, LAN tool linking to Campus Web sites, providing open and vocational skills training opportunity.

III. Methods

A. Searching Strategy

In this step, that is strategy for searching the articles that were published between 2015 until 2020. The articles were searched in Springer database with keywords "virtual reality" and is obtained 998 of articles. Searching articles is done in Science Direct database with keywords "Virtual Reality" and "Vocational" and is obtained 311 articles. Total obtained articles are 1309.

B. Inclusion and Exclusion Criteria

The obtained articles then analyzed by inclusion and exclusion criteria that is described in Table 1. The search of virtual reality application is focused on education and vocational school from published articles, journals, and proceedings.

TABLE I. Inclusion dan Exclusion Criteria

Criteria	*Inclusion*	*Exclusion*
The focus of the article	Virtual reality in vocational education and training.	Articles those are not focused on cirtual reality and outside vocational education and training
Publication date	From 2015 to 2020	Prior to 2015 and after 2020
Publication type	Journal and proceeding	Book chapter, technical report, opinion
Research methods	Quantitative, qualitative and mix method	Conceptual article
Language	English	Outside of english

C. Article Selection

Obtained articles from database then analyzed to excluded and included by studying their titles and abstracts. from the search and criteria of articles, the next step is to how to choose articles. The process of selecting articles which can be seen in Figure 1.

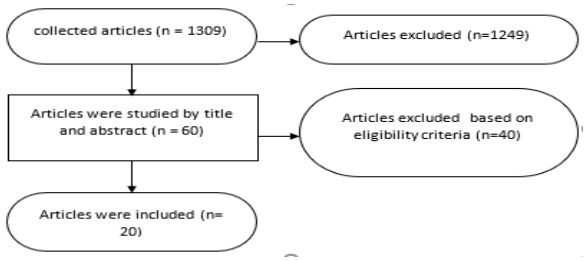

Fig. 1. Flowchart of choosing the articles.

IV. Data Extraction

To obtain the result of this research, we studied all of 20 articles that are chosen from several journals.

TABLE II. Chosen Articles

Journal	Total
British Journal of Educational Technology	2
Education and Information Technologies	1
IEEE	1
Educational Technology Research and Development	1
Eurasia Journal of Mathematics, Science and Technology Education	1
Smart Innovation, Systems and Technologies	1
Virtual Reality	2
Journal of Intelligent and Robotic Systems: Theory and Applications	1
Journal of Autism and Developmental Disorders	1
Elsevier	5

Table II. Cont.

Journal	Total
Applied Mechanics and Materials	1
Virtual reality & intelligent hardware	1
Routledge	1
Pupil: Int. J. Technol. Enhanc. Learn	1
Total:	20

Our analysis is divided by content and methodology. In content section, we explain science discipline/study program that control the application of virtual reality in earlier research. And for methodology section, we describe method design type (qualitative, quantitative, mixed) and instrument that is used in earlier research (interview, observation, questionnaire, or test). Content and methodology of the application of virtual reality in vocational education can be seen in Table 3.

TABLE III. METHODOLOGY AND RESULT IN THE USE OF VIRTUAL REALITY IN VOCATIONAL EDUCATION

Literature	Aims	Method	Result
[6]	Knowing an Immersive Virtual Reality (IVR) can enhace conventional method in design skill.	In this research, an experiment is conducted to 30 students from vocational school in Swiss. The researchers use 2 x 2 design experiment	This research shows efficacy of IVR application in supporting the skill of design and how this efficacy can be improved by joining this with conventional practice method.
[7]	This review is aimed to know the use of HMD in education and training	This review is about all peer-reviewed researches that documented experimental or quasi-experimental studies that are relevant with object of study of this research. The search of articles is limited to peer-reviewed publications. Because the focus of this study is HMD generation today, then to validate string of search, several alternative keywords are applied such ass virtual reality, cyberspace, HMD.	This review identifies several situations where HMD is useful for skil acquisition. This includes cognitive skill that is connected with memory and understanding information and space and visual understanding; psychomotoric skill that is connected to head movement, such as visual and observational skills; and affective skill twith emotional response control in difficult situation and stress. Outside those above mentioned scoops, HMD does not have advantage if compared with superficial technology or traditional instruction and in several cases even it is proved contra productive because the widespread of cyber sickness, technological challenge, or immersive experience is disturbed by learning tasks.
[8]	This research aims to know the comparison of immersive environment efficacy to two dimensional learning content for labelling tasks of motorcycle with retention evaluation and recall.	This research is conducted with two groups of participants; interaction VR group and interaction 2D based on tablet. Interaction capability of VE that is enhanced is hypothetically to promote knowledge retention and to enhance instructional utility for the solution of immersive learning experience.	The result shows integrated VR as a bridge between theoretical learning script and practical work. The improvement of experiment group along delayed evaluation in script shows consolidation and significant increase from declarative memory of participants. Considering time and effort that is invested by every group is compared by each performance achievement and proposed the balanced integration from VR learning representation and non-VR in designing learning program. The comparison of interactive 3D learning content based on tablet and VR experience also become a promised area for further exploration. More experiments about this comparison in a certain amount of time can enhance understanding about effective strategy for representation.
[9]	To know the difference of the use of immersive virtual reality and desktop virtual reality for handling the science learning by virtual simulation.	This experiment uses repeated-measured crossover that involves all participants by using immersive virtual reality (Samsung Gear VR and Samsung Galaxy S6) and DESKTOP VR version from virtual laboratory (in standard computer). All participants randomly is divided into two groups: first group use immersive virtual reality followed by desktop version of VR, and second group uses two platforms in the reversed sequence. Both groups begin the pre-test to measure background information. All of the participants has maximum twenty minutes to play virtual simulation in every platform to enable the comparison. After using every virtual simulation platform, all of the participants finishing the survey that measure their experiments in playing the simulation in every platform. Samples are 104 university students (39 are females).	The result of this experiment shows that there is significant difference between two platforms on 11 from 13 of constructions. The greatest difference (effect measure higher than 0,8) is found in the variable of present percentage (d = 1,67), motivation (d = 1,28), approximation to control (d = 0,99), and pleasure feeling (d = 0,94). By that, we conclude that emotional value from immersive virtual reality from learning simulation is significantly higher than desktop VR. This is main empirical contribution from this research.

Literature	Aims	Method	Result
[10]	This research is focused on the effect of multimedia application in automotive vocational school on the satisfaction of student and efficacy of learning.	This aims automotive technology application that is opened in higher learning in vocational school in Shanghai, 216 of students is followed the research for sixteen weeks (3 hours every week for total 48 hours) in quasi experiment. The obtained data is analyzed with SPSS, regression analysis and variance analysis is applied with several hypotheses. Validity refers to measurement tool that can really measure what is measured by researchers. Generally speaking, validity is divided by content validity, criteria validity, validity construction. Item that is used in questionnaire is referred to domestic researchers and international researchers. Pretest is conducted before distributing formal questionnaire that questionnaire shows content validity. Virtual reality technology, learning satisfaction, and the result of learning is tested by causal relationship and linear structure relationship, and data administration is based on correlation coefficient matrix and observation object. The result of analysis with Linear Structural Relationship Model shows the whole model is fit in appropriate trajectory so as to give a convergent validity that gives advantage and predictive validity. Correlation coefficient item-to-total is used to test validity of questionnaire construction, that is reliable analysis, correlation coefficient item-to-total that is obtained is applied to assess the questionnaire content. Correlation coefficient item-to-total of dimension is higher than 0,7 shows a certain construction validity from questionnaire.	The result of this research shows that computer multimedia education todays show advantages from the creation situation and visualization of interface and reusability of elements. Learning designers can flexibly apply technology to give learning strategy. Applying computer multimedia education for automotive school can study and develop and design learning materials in media production, that includes point organization, pictures, photos, close-up pictures, repeating pictures, subtitles, slow motion, distance scale, color effects, dynamic effects, sound effect, high speed turning effect, and musical background. Also, drawing aid and photo can determine learning content and static picture of photos can be added on time and dynamic audio learning materials, such as relevant photos that is provided by teachers.
[11]	This research is aimed to know the application and the making of Virtual Reality as education and training tool in medical school.	In this case, interactive simulator of Virtual Reality from our system with 360 content, we use Box SDK and Gear Visual SDK. Two different technology that is used to develop Virtual Reality System. The first one gives possibility of developer to make system for different googles and gadgets, while Gear VR SDK, also known as Oculus Mobile SDK, is used to create virtual experience for Gear VR and Oculus googles. In this system, we focus on a unique element that can be found in operation chamber. So, when user see a certain gadget, this system will show him an information about that gadget. It is important to create visual experience that is so realistic so we consider this while programming different functions, such as video that is visualized in monitor.	Everyone can understand the system operation and use it perfectly only in a couple of minutes after executions. This is software engineering that can be used in society and basically it measures of how easy a system can be used (UNE-EN ISO 9241– 9:2001). On the other side, this tool can inform user what steps must be taken in lumbar trans pedicular fixation that is of course is the main goal. It can be achieved by three different ways: Visualization by 3D animation from the tasks to be done. Real operation video from every procedure. Interactive simulation where user must test what he has learned and do every step by himself.
[12]	This research is aimed to study the learning program that is based on participation simulation in teaching in Virtual Reality environment that is supported by learning condition that enables student to take alternative perspective.	This research adopts experimental pretest-posttest control group design to test the effect of the implementation of simulation that is supported by VR, compared to direct simulation, about the teaching of science development of participants, that includes process that shows alternative perspective that is taken for learning, is also collected. This research is conducted to 42 assistants of lecturer that are recruited in chemistry department in land grant university, USA. Participants are 30% of females and 70% of males. None of them has VR experience before this. From 42 participants, 69% do not have teaching experience whatsoever and 33,3% is non-native English speakers. Individual participant randomly is tasked to simulation group that is supported by VR (n = 20) and direct simulation group (n = 22). There are higher percentage from assistants of lecture without experience in VR simulation group (80%) than direct simulation group (59,1%) because of simple random task.	This research focused on the development of science education for all participants after simulation-based training. Direct simulation participants perform better in science test after session than VR simulation. Qualitative data shows many challenge and chances in learning process based on VR simulation, that includes togetherness experiences, but it is not efficient from diving-in learning perspective and outside walking along collaborative virtual in hybrid learning room.
[13]	The aim of this research is to develop digital interface of human-machine on budget to improve training, result and achievement in real world.	This research follows post-test quasi-experimental design. As many as 160 (males = 90, females = 70) middle school students in Taiwan, aged 15–16 years old, divided into four individual groups, that includes control group (CG) and three experimental groups (EG1, EG2, dan EG3). All of the participants in this research have experiences before this in playing game. Independent variables in this research is training mode. (that is, aim distance in real world vs aim distance in virtual interactive 3D vs combat training in real world) Dependent variables are learning result and motivation. In this research we use OpenCV	The result shows that students in EG3 achieve significant scores (p\.01) higher than in EG1, EG2, dan CG (as shown in Table 2). This shows that experimental group (EG3), that adopts aims distance in real world in VR 3D and combat training mode, performs better than students in other groups (EG1, EG2, dan CG). Besides that, there are different tools between different VR training mode that we test. Same as the finding in earlier researches, Hummel

Literature	Aims	Method	Result
		and Unity as software to develop automatic calibration and real world shooting trajectory in 3D real world. Also simulated pistol T91, laptop (with webcam), projector, and monitor are used as hardware. The result of learning of students are scored from shooting distance in real world as shown in picture. To measure the motivation of students, the questionnaire is spread. To maintain the content validity, a group of experts in learning technology review the tools. Questionnaire is build based on comments and input from reviewers. Questionnaire is from 70 participants, and includes ten items, and can be found in "Additional Information". All Cronbach (internal consistency) konsistensi internal) for questionnaire is 0,796.	et.al (2011) and Ku, et.al (2014) and Sung et.al (2015), this research concludes that learning program that is based on serious game enhances learning result of students.
[14]	This research is proposed the work frame of online systematic virtual reality that enables student to do role-playing, dialogical learning, and social interaction for the safety of construction and health education..	Framework of this research includes three models as follows: 1) Cooperative Distributed Safety Learning (CDSL) to understand the root of accident in construction location; 2) Hazard Inspection and Safety Cognition (HISC) to reflect safety theory through danger inspection in social VR environment; 3) Active Safety Game-based Learning (ASGL) to enhance practical capacity with game training of safety in virtual 3D environment. System prototype is developed and evaluated in virtual script that comes from real safety case to identify benefit and limitation of system.	The result of this research concludes that social/collaborative virtual reality platform enhances safety of construction and health education effectively.
[15]	The aim of this article is to give a modern approach and example of systematic virtual reality/augmented reality and experience to enhance the learning process and vocational school to the real world.	This is a short and representative paper about how far virtual and augmented reality have roles in the development of K-12, competency of students in 20 century. The choosing process of article includes article with an appropriate criteria. the main focus is on disable student with mental and space disability. High efficacy is shown in the application of VR/AR compared to traditional learning method. As a whole skill learning is divided into six degrees: (1) retention and memory (2) motivation and focus (3) skill of space and visual (4) critical thinking (5) collaboration and communication (6) immersion, creaticity and emotional	The promised result shows that VR/AR environment improves many advantages from invested time and financial source in K-12, educational control and tertiary. Technology tool such as VR / AR improves digital age literacy, creative thinking, communication, collaboration and problem solving skill, that is called as twenty first skill that is necessary to change information rather than just receive it. VR/AR improves traditional curriculum to enable provides different learning tools for students.
[16]		Short survey is conducted to 23 from 26 participants in this research to evaluate their vocational education after six months of follow-up with focus on whether they achieve competitive position or not (worker or competitive volunteer). Logistic regression indicates that trainers of VR-JIT have greater chance to achieve competitive position better than control (ATAU 7,82, p\0,05). Earlier evidence shows VR-JIT is an intervention that shows a promise to enhance vocational study in young adults with high performance ASD. Participants are called by phone or through email and are instructed to finish follow-up short survey. They are not specifically pushed to count the support from assistance to answer questions a ccurately. This survey includes participants to reflect the last six months after they finished efficacy study.	Result from controlled efficacy random test before this, suggests that virtual reality job interview test enhances student's skill with ASD, but not not with controlled ASD.
[17]	This review is a foundation to the discussion about the difficulties and chances of these tools to be used in cognitive learning and simulation.	In this paper we want to highlight how the interaction between digital and real tools can be utilized in the learning process. Research shows the steps in the learning process using LF and digital models. As mentioned, it is important to develop learning materials and methods that allow deep understanding and are preferably stripped of unnecessary information; "Noise". In step 1 teachers and students can use digital models for pre-briefing. What will happen in physical LF? This can easily be done with remote students as well, through the use of virtual classrooms. During the LF simulation, students are "humans" in model 1, and act as operators, engineers etc. simulating an actual factory. The lessons learned form the simulation that is run need to be analyzed, discussed, and reflected in the debriefing phase. This stage proved to be very important for learning outcomes. Here again the digital model is the basis of this analysis. Finally, the student can connect the two "worlds" and gain increased knowledge about both such manufactures, but also on the interaction between the digital and physical worlds in modern	This writing is a concept description, gives an input to society about aspects that is necessary to be concerned with in the relationship with the use of VR/AR/digital twins in context learning factory.

Literature	Aims	Method	Result
		"industy 4.0" manufacturing plants.	
[18]	The main focus of this article is to give the conditions that can be evaluated for the VR application in factory.	The methodology of this paper is based on an agile framework. The identified requirements are stored in the product backlog. The requirements must be embodied in a minimum viable product which will be repeatedly improved by user tests. To determine the category of all requirements, the requirements are classified with the Kano model. Prior to implementation, the classified requirements are sorted taking into account the implementation effort and dependencies between requirements. User tests of today's virtualized environments allow the identification of new and changing requirements, which must be adapted.	The survey of participants revealed the following results for the presented requirements: trainees and coaches classified the attributes of virtual coaches, multiplayer modes and different levels of difficulty as attractive attributes. In the context of realistic tasks, supportive information, and support from trainers, attributes are assessed as attributes that should be a software product. For the survey group of trainers, the possible cost reduction compared to conventional courses in a learning factory is a one-dimensional attribute.
[19]	The aim of this paper is to create training environment for simulation and controlling pneumatic process for Technical Process of Automatic Industry.	The virtual lab was developed using Unity Pro 3D software and consists of: (i) With the help of Oculus RV eyewear students visualize and be able to move in a realistically designed environment with immersive sensations that allow interaction with the system through manual motion recognition. The teaching process begins when students receive a pneumatic circuit problem about the use of two pneumatic cylinders. (ii) After students complete the proposed problem, use the virtual laboratory to start modeling the proposed pneumatic solution. Here students interact with a virtual environment to properly connect cylinders, stroke end sensors, and pneumatic supplies. In many cases the mechanism does not work properly, so students have to rebuild the practice, which leads to an increase in manual skills and this activity improves failure-seeking skills. (iii) When pneumatic problems are solved and simulated students send control instructions using the MQTT protocol to a Raspberry Pi board connected to a real FESTO electro-pneumatic system to demonstrate its functionality in a practical form.	This research has achieved an efficient immersion of the user education easing of different electro pneumatic control algorithms avoiding the traditional education methodology. With this technology, the vision of adapting student training and developing more efficient methodologies, becomes a conceivable goal for every educational unit. When talking about the interaction of a real laboratory with a virtual reality interface, it is necessary to take into account the response times and delays inherent in the virtual environment and the proposed control system. Due to the use of the MQTT protocol, which consumes very low resources and bandwidth, an efficient response time has been achieved
[20]	This article introduce the 3D Max model and the use of VRP software in making systematic aim in virtual field, where it can explore every aim with selection paths. Virtual reality work "Years as Song" is created by virtual reality technology that shows creating method.	The VR software uses the Zhongshidian VRP scene model optimization effect which is very large on the demonstration speed. If you don't optimize the scene model at an early stage, it will lead to renovations back in 3d Max in the final production stage when optimizing the model again. If that happens, repetitive work will reduce efficiency. Therefore, it is necessary to pay attention to the optimization of the VRP scene model when creating the scene and to follow the VR VRP method to imitate. In the Years as Songs modeling, he adopted the single-sided model. At first, small page design and indoor arrangement by CAD; then set the model with 3D Max, lead CAD document in 3D Max and lock it, open vertex capture, use line drawing in spline extrude stretch, make poly door and window edit, delete surface which will not be visible map on parting surface, adjust coordinates; make individual doors and windows and place them in their proper places; drawing indoor furniture; through the marge order lead in the article on the page after it has been adjusted according to the existing model.	The introduction of VR technology in higher vocational education can effectively get rid of the limitations in practical training, experimental equipment, time, sites and funds, and is beneficial to comprehensively and effectively cultivate technical talented people. At the same time, it will be easy to avoid the danger factors such as scalding, crushing injury, crushing, and cutting may occur in the training course, and it can also increase students' motivation to improve their operative ability, innovation and adaptability to change. In short, this technology promotes the careful combination of teaching and production positions, and enables students to adapt to new job positions.
[21]	This paper is aimed to identify the application and understanding the trending research DHM in manufacturing industry and to give reference materials to develop manufacturing virtual and DHM	This applies in industry where DHM is used. Compared to application, this gives a deeper description about GHM application. There are six groups: menjadi enam kategori berikut: (1) simulation and evaluation of engineering and maintenance (2) automotive scoring; (3) design and optimatization of workplace, (4) simulation of human and robot (5) behavior study of human (6) education and training .	
[22]	This research is aimed to overcome the difficulties in teaching the real world and problems in working environment of	This research uses simulation in Vietnamese furniture manufacture factory that enables student to experience and observe furniture production from VR to overcome difficulty in learning environment today. With that, we recruit 29 new students from furniture and wood working department and divide them into experimental group (N=15) and control group	Applying VR technology on the vocational training of batch furniture effectively to improve the familiarity of student to production situation that is fast and dynamic in furniture production line.

Literature	Aims	Method	Result
	students in the field of wood working (furniture) in Taiwan under the change of condition of furniture production.	(N = 14). They are trained with real furniture production case that is suited with massive furniture production, that includes paper based test, equipment configuration, writing design table of production.	
[23]	This paper gives study about landscape of Augmented Reality (AR) and Virtual Reality (VR) applications in fields of architecture, technic and construction, and propose the agenda mengusulkan agenda penelitian untuk mengatasi kesenjangan yang ada dalam kemampuan yang diperlukan.	A series of explorative workshops and questionnaire with participation of 54 experts and 36 organizations from industries and academics. Based on collected data from workshop, there are six cases of the use of AR and VR that are: involvement of interested parties, design support, design review, construction support, operational support and training, and management, and training. Three categories of main researches in the future has been proposed: (i) engineering equipment, that includes research that enables a strong equipment that can be used in laboratory practice, such as crude condition and complex from construction location; (ii) flowchart of data management; to handle data and efficient process by AR and VR technology, and; (iii) new skill; that includes new research that is needed that can add new features that is needed for a certain construction industry.	This research gives an important information for workers to inform the adoption decision. To researchers, this provides research road map for the future research. This is a basic study that categorize AR and VR in construction industry and provide road map to guide the future research.
[24]	This research is aimed to propose the use of systematic mapping to identify design element from the recent researches that are dedicated to apply VR in higher learning institution.	This research applies the approach to systematic mapping in literatures and extracting main information from documents indexed in four digital science libraries. Our research is aimed to get description of relationship between application domain and learning content and also design element and learning content. Based on our result, we proposed agenda for future research and recommend the application of VR in higher learning institution. Next, to answer the question about wide field, the relevant topic in this field, and research trend we recommend mapping study, that is a systematic literature review. Differ from standard systematic review, that is pushed by a certain question of a certain research, it shows that study of mapping can give a wider view and classify paper main research in a certain domain that is studied. Research question that is proposed in this kind of research has a high abstraction degree and includes problems such as: what sub-topic that has been studied, what empirical method that is appropriate to support systematic review with detailed approach. Example of applied approach to mapping study for literature review is work of Wendler (2012). To achieve the aim of this research, we proposed several questions focusing on systematic and structuring the research about VR application for higher learning.	This analysis has found several gaps in the implementation of VR in higher education environment, it is not common to consider learning theory in the development of VR application to help and guide toward education result. Besides that, evaluation of VR application in education field especially in the application of VR instead of focusing on learning result and immersive VR, most of them have become an experimental work and development and not a routine work in actual learning process. But nevertheless, VR most likely become a promised tool because this research identify eighteen application domains, shows the better acceptance of technology in many science disciplines. Gaps that are identified are referred to fields that have not been explored from VR designed for education, and can motivate future work in real world.
[25]	The aims of this paper is to give didactic-methodical concept for virtual vocational learning and training by means VR and AR technology.	Integration of didactic-methodical and technical technology in learning dan education process need concepts that are applied through four main stages: analysis, design, implementation, and evaluation. Because the researchers are double VET institution for disables, autism, and significant social interaction difficulties Our concepts also are applied to other target groups. Virtual environment offers the ability to interact and experiment with items and construct with the same way as they do in real world. Ar-Glasses promises through the application of free visualization script the concept of learning; the user is supported by information and virtual object based on added context. Our method is based on the object of education, cognitive and psychophysiological state of trainers, technological aspect and pedagogical strategy of education that is focus oriented. In this paper, we give several examples of technology applications in VET, mechatronic-automotive engineering, electro-technology and automation, technical product design, information technology, and in-house vocational school	This test is aimed to enhance interface design process. The next test is to evaluate the data history to measure how far the goal is achieved. Reversibility of actions is also able to bring strategy into the question and to evaluate new effect. Technical test is also done to optimize development process as whole to improve quality, safety, and endurance, and cost and functionality if necessary. This method is suitable based on observation and behavior analysis, content analysis, and media, performance test, comparative study, interview survey, cost-efficacy analysis, etc.

About twenty articles that are analyzed: learning by VR is effective in improving psychomotoric skill of the students because VR can be used as complement medium before students doing laboratory practice, and can improve safety and health effectively. [14]. It is easy to avoid dangerous factors such as self-injury and injury caused by machinery [20]. In laboratory practice, VR can improve cognitive skill that relates to memory and understanding of concept of space and visual

concepts, affective skill that relates to emotional response control in difficult situation [7].

VR application can be used as alternative medium to improve student skills. Efficacy of VR in supporting skill can be enhanced and joined with practice method. Efficacy of VR in supporting skill can be improved by joining it with conventional method of practice [6]. Besides that, integrating VR in education and learning can improve skill of student in competing with others, in communication, in improving digital age literacy, creative thinking, communication, collaboration and solving problem skill that is mentioned as twenty first skill [15].

Immersive technology in VR can simulate the real condition for student. That can give positive effect for understanding and critical thinking of the student. Applying VR technology in vocational education can effectively improve the familiarity of student in production situation that is fast and dynamic in production line [22]. The use of VR in vocational education has an important role to enhance psychomotoric skill of student. That can help student to prepare laboratory practice, so student can have more confidence when doing laboratory practice. This can relate to learning motivation, student with confidence can be more motivated to study.

This immersive technology is only present in VR, so then VR can be used as alternative medium that can be applied in learning process. To produce VR with positive effect then VR must be designed with these aspects for consideration: (1) study of human behavior in an event (2) Designing and coring the collaboration system between human and robot; (3) combination with AR; (4) Enhancing in moving plan, and (5) Evaluation that is systematic and comprehensive [21]. The result of analyzed articles also found several gaps in applying VR in higher learning environment such as learning theory usually is excluded in the development of VR application. Besides that, evaluation of VR application in education field, more often just become an experimental work and development and not a continuing process in actual learning [24].

V. Conclusion

This literature review states that the earlier research that is conducted about the application of Virtual Reality in vocational education. Several databases are chosen to pick articles that were published in 2015 to 2020. To fulfil the object of this research, all articles that are found are classified based on analyzed results. That VR can be used in vocational education such us medical, enhancing learning capability, and laboratory practices. In articles that are found, it is identified eighteen domains of application, shows the better acceptance of VR technology in many science [24].

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