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Need for Virtual Reality-Based Learning at Vocational Education in Indonesia

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ABSTRACT
This study aims to describe the potential of virtual reality in vocational schools for industrial training programs. This descriptive study involved respondents consisting of students, teachers, and industry. Virtual reality is a technology that allows users to enter and interact with virtual (virtual) worlds because virtual reality is a computer technology that combines certain input and output devices where users can interact deeply with their virtual environment as if they were in the real world. Far ahead with the development of Virtual Reality (VR) technology in Indonesia in education, this system can be used in various fields of education such as practical workshop simulations, disaster simulations, engineering simulations, occupational safety simulations (P3K), and others. By implementing an innovative learning system during a pandemic and using virtual reality (VR) technology, Indonesian education is hoped to continue to develop, which is by paragraph 4 of the Law. Sustainable development goals agreement, ensuring adequate and inclusive quality education to promote lifelong learning opportunities and rights for all. Quantitative data were analyzed by descriptive statistics and qualitative data by inductive techniques. The results show that the role of industry in SMK is as a place of practice for students, as a place for work internships, and as a place to learn about industrial management and insight into the world of work. For the implementation of industrial training programs in large, medium, and small industries, an assessment score is obtained. The overall average level indicates that they are ready to contribute. The potential for developing virtual reality in vocational schools is said to have great opportunities based on the many applications of virtual learning and training applications implemented in vocational schools and their benefits in increasing curiosity and enthusiasm for learning, encouraging students to think critically and creatively, risk security, cost reduction, and practical knowledge transfer processes. This is evidenced by the participation of respondents in practical activities that show the effectiveness of resource utilization, immersion, and real-time interaction, increased interest, increased participation, and the effectiveness of practical exercises on average indicating that they are happy to use virtual equipment when compared to real equipment.We hope that the outbreak of the Covid-19 pandemic will not only add to panic in the public space but can also be a starting point for Indonesia, especially in education, to continue to create the world`s golden generation.

Keywords: *Virtual Reality, Training, Vocational High School.*

1. INTRODUCTION

Vocational high school is one of the educational institutions that develop graduates with the skills, competencies, and expertise to succeed in the world of work. Studying in a vocational school not only provides the skills needed for entrepreneurial or industrial work, but also helps to achieve the goals of a vocational school. This is also achieved through relevance to the world of manufacturing that meets the needs of the economy and industry. Behind this is the government's policy to network and coordinate companies and industries through needs-based training in vocational colleges. Business and industry are growing rapidly in the fields of technology and science.

Regulation of the Minister of National Education Number 22 of 2006 states that professional education is aimed at participating in professional programs to improve and train intelligence, knowledge, morals, noble character, and the ability of students to live independently. As a result, schools must equip students with competencies and skills that meet the needs of the world of work. Competence as mastery of tasks, skills, attitudes and appreciation needed to support success [1]. According to this definition, competencies include the knowledge, skills, and attitudes necessary to successfully perform a job, and curricula are required to achieve progressive competencies.

One of the pillars of vocational revitalization is industry-specific curriculum. According to the Ministry

of Education and Culture's Director General of Primary and Secondary Education the four points include curriculum revitalization, educators and education staff, collaboration, and alumni [2], with some beginning with curriculum planning, development, and evaluation. In line with this, emphasize that learning strategies in vocational secondary schools should guide the linking and coordination of multiple needs-based programs [3]. This is where the business world and industry can really help college graduates find work. Fundamental theory and practice take place in schools, whereas productive skills take place in business and industry [4].

The results of the vocational training process must meet the needs of Industry and the world of work. Therefore, vocational high schools must be relevant to the needs of the ever-changing labor market so that they can become a dynamic and adaptive forum to follow industrial developments at the regional, national and global levels [5].

It is undeniable that the needs of the labor market itself are directly proportional to the needs of consumers and ongoing economic developments. Over the past decade, the field of technology has significantly improved with the rapid development of technology in various aspects of human life. One of the influences that influenced the industry, led to the birth of the Industrial Revolution 4.0 wave. The birth of the Industrial Revolution 4.0 has an impact on the needs of the world of work for the talents it needs [6]. Therefore, aspects of education, particularly VET related to industry, must change with the emergence of new industries and the increasing needs of certain industrial sectors.

The Industrial Digitalization Era 4.0 means that Vocational High School graduates will be subject to the requirements of the Business and Industry World in accordance with current technological advances. Investigations and research on the effectiveness of the implementation of learning in Vocational High Schools are especially needed to attract the best graduates to the Business and Industry World in the current era of digital industrialization 4.0. The aspiration of Vocational High School graduates is to be able to work independently according to professional programs or be fully involved in the Business and Industry World. This raises the question of where graduates are looking for work. The basic result of this research is the creation of quality students with industry-based competencies that meet the demands of industry in the Industrial Revolution 4.0 era, which are independent, accountable, and industry-based competencies. The strategy for implementing industry-based education includes: 2) Factoring education program 3) Internships in industry. 4) Complete the Professional Proficiency Test by the Business and Industry World with the appropriate requirements/conditions. 5) Professionals in the Business and Industrial World as guest teachers for Vocational High Schools. 6) Relevance of Vocational High School facilities and infrastructure with industry.

Efforts to increase and fulfill manpower needs can be carried out from various sectors, including education. Of course, by encouraging education providers to improve the skills of their graduates and by constantly following the developments and needs of the industry, this is directly proportional to the acceptance of graduates of various levels or levels of education. Especially in VET, both at the secondary and tertiary levels. In the end, according to [7], the nature of VET must adapt to the needs of the world of work, so that it is more flexible and adapts quickly to changes. Responding to the rapidly changing world of the digital industry, vocational high schools, especially at the secondary education level through the Ministry of Education and Culture, need to implement various programs to support the development of the professional field in line with the times. To that end, the President issued INPRES No. 9 of 2016 concerning the Revitalization of Vocational High Schools, after instructing the Minister of Education, Culture to prepare a map for the development of Vocational High Schools and to increase link and match connections with the industrial world.

On the other hand, concerns about vocational education in Indonesia and other developing countries are that the existing facilities, especially for practical activities in schools, are inadequate and not supported by industry [8]. Students do not develop their skills optimally because of limited practice opportunities. Therefore, if you only study at school, the quality of graduates does not meet the requirements of the world of work and industry. To overcome this problem, it is very important for VET Indonesia to adopt a learning model that is in accordance with students' skills.

2. THEORITICAL STUDY

2.1 Training Program in SMK

The types of government training in vocational training are classified according to [9] into five categories: general schools, technical schools, universities of applied sciences, and dual training systems. In addition, [10] argues that there is cooperation between educational institutions and the industry in providing education through a dual system training called industrial work practice adapted to the competencies possessed by students after obtaining the theory that has been obtained at school. Training is carried out to ensure the effective performance of workers, guided through training programs, evaluated, and feedback on their strengths and weaknesses. This is reinforced by [11] who explains that vocational education must focus on education and training, because training can develop human potential to the fullest. Training and experience will gain knowledge, and knowledge gained through training can be measured by academic tests or exams by [12]. In training learn knowledge, skills, abilities, and behavior. Based on the elaboration of several opinions, it

can be concluded that the job training carried out is tailored to the needs of students, which is a transition process in schools and job training is carried out in industry where the curriculum is combined with job opportunities until school competence can be achieved. Training is carried out in schools to gain experience so that students increase their knowledge, skills, and behavior as work provisions. After having the training experience provided by the school, students can also change attitudes or behaviors that are ready to go directly into the world of work. Therefore, Vocational High Schools need to improve their training for students to have competencies that can meet the demands of the business world and the industrial world.

According to Charles Prosser quoted by [13], there are 16 principles of vocational education and among them related to the role of industry there are three principles. Vocational Education will be effective if (a) the training tasks are carried out with the same means, tools and machines as prescribed in the workplace and (b) train a person in the habit of thinking, and working as required in the job itself. In addition to these two principles, there are other principles related to the role of industry, namely (c) VET is efficient when the environment in which students are trained matches the environment in which they will later work. This efficiency is achieved because the industry no longer needs to organize training centers. In order to meet these three principles, vocational schools require very high costs. Especially if you want to meet all of Prosser's principles.

2.2 Virtual Learning

With the development of today's technology, experimental activities have begun to shift slightly towards virtual activities. However, virtual activities do not necessarily eliminate the values that can be developed in real experimental activities. Based on several research results, virtual experimental activities are effective in increasing mastery of concepts [14][15][16][17].

Virtual Reality (hereafter referred to as VR) is a computer-based technology that combines specialized input and output devices that allow users to interact deeply with virtual environments as if they were in the real world. VR allows developers to create virtual environments with potential for simulation [18]. The visualization that occurs when using VR in a virtual world consists of visual, auditory, or other stimuli.

VR technology is widely used in multiple industries such as entertainment, medical, education, aviation, architecture and military. VR is very useful for simulating things that are difficult to represent directly in the real world [17]. For example, in the military field, VR can be used to present a virtual war simulation instead of sending soldiers to the battlefield as an exercise. Soldiers can feel like they are on the battlefield without having to go directly to the battlefield. Of course, this may be more practical and economical [19].

Virtual reality (hereinafter referred to as VR) is abbreviated as VR. VR is a computer-based technology that combines specialized input and output devices that allow users to interact deeply with virtual environments as if they were in the real world [20]. With VR, developers have the potential to create virtual environments as simulations [21][22]. The visualization that arises when using VR in virtual worlds consists of visual, auditory, or other stimuli [23]. His 3D coordinate system in VR follows the Cartesian coordinate system. This is because the user can view objects in the virtual world from any direction, from above, below, left, right, behind or in front [24]. The X-axis is used to view objects from the left or right, the Y-axis is used to view objects from above or below, and the Z-axis is used to view objects from far or near.

Moreover, Virtual Technology is at the forefront of technological developments. Recent advances have made this technology more accessible, and now students with disabilities have the opportunity to participate in virtual experiences, although these advances also benefit students regularly by creating a more accessible experience (for example by using their mobile device, or by accessing a virtual space when enrolling in a distance-taught course). In summary, there are four main aspects regarding the advantages of using virtual technology, which are:

1. Virtual technology increases student motivation and engagement. Students have an immersive experience and feel like the protagonist while studying 3D models that enhance the learning experience [25][26].
2. Virtual technology enables a constructivist approach to learning. Students can freely interact with virtual objects and other students. As a result, students can explore, experiment, and receive feedback for an experience that enhances learning.
3. Virtual technology has become affordable. Recent technological advances have made VR/AR easily accessible on smartphones, tablets, and video game devices. No more complicated devices, students can access VR content shared on popular online platforms like YouTube. Additionally, students with disabilities can easily access the virtual environment and interact with virtual objects and other students.
4. Virtual technology enables more interaction than traditional learning materials. With VR/AR, students feel immersed while interacting with concepts, objects, and processes using headsets, touch gloves, and motion sensors. This immersion allows

experimentation in environments with realistic objects that are otherwise inaccessible [27].

3. RESEARCH METHODOLOGY

This research is a descriptive research with a quantitative approach. Descriptive quantification aims to describe goals using numerical data. In addition, oral/qualitative description of a goal can be achieved by studying a particular organism, organization, or phenomenon in depth and detail through observation or analysis to generate qualitative descriptive data, data in the form of text or words. is also done. People's language, observed symptoms and behaviors. Data sources for this study included school administrators, teachers, educational staff, and students who responded to the study. Data were collected by creating a questionnaire and interviewing respondents. Two questionnaires and interview guidelines act as tools. Interviews and observations were conducted to collect data on delivery models or phases of virtual reality training and the potential use of virtual reality technology to improve the quality of industrial training.

4. RESULTS AND DISCUSSION

4.1 The Role of Industry and Vocational Schools

There are already many vocational schools that use the world of work and industry as a training ground or simply give their students an insight into the world of work. Below are some of the business and industry features in action.

1). Industry as a Place for Student Practice

Many SMKs do not have the equipment or machinery to implement competency standards and target setting, and use industry as a practice. The problem is, the number of laboratories currently does not match the number of students needed for practice. In addition to related issues, there is a government policy that encourages the number of SMKs to increase to 70 percent of vocational high schools and 30 percent of general high schools.

2). Industry as a Place for Interns

The apprenticeship system is the oldest vocational education system in the history of vocational education. The apprenticeship system is a fairly effective system for educating and preparing a person to deepen and acquire more complex skills that are impossible or never attainable in a school class group. Study with an expert. The training system also helps apprentices understand the work culture, the required professionalism, quality culture and customer service. The training system is practiced in some schools. A dual system inherited from Germany has also been introduced in Indonesia, and has been very successful before the crisis, with the support of various companies and industries. This dual system was then well supported by the government through the issuance of Directives (MoUs) between the Ministries of Education, Labor and Industry. Industry is encouraged to cooperate with professional schools and accept professional students.

3). Industry as a place of learning Insights into the world of industrial management and work

As such, schools have used industry as a place to learn about production management and organization. Professional students sometimes observe how machines and products work by indirectly learning about product quality and efficiency. In addition, students also learn about management and industry organizations, learn about the business world and how companies operate, and gain insight and knowledge of the business world. Through learning management and organization, students can also broaden their horizons in the world of entrepreneurship. Professional students may use the industry as an object of tourism learning simply by observing or remotely observing the production processes in the industry. We may also receive information about organizations and their managers from industry managers.

Schools have long used industry as a learning ground for production management and organization. Apprentices may observe how machines and products work by indirectly examining product quality and efficiency.

4.2 Fulfillment of Practicum and Training Facilities and Infrastructure at Vocational Schools

The budget for the procurement of practical tools and materials is still insufficient, so that more and more new vocational schools are unable to meet the needs of tools and materials that meet the requirements of the World of Work curriculum. Another obstacle is that not all students meet the minimum proficiency standards set by the industry.

Based on the following observations, the distribution of learning infrastructure in vocational education is shown in the figure below.

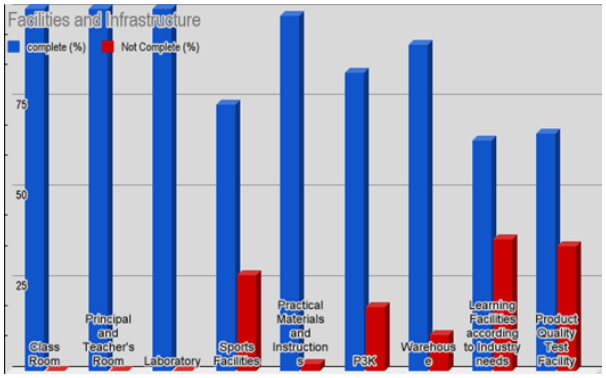

Figure 1. Facilities and Infrastructure in Vocational Education School

Figure 1 it can be seen that Learning Facilities according to the needs of the business world and the industrial world are still low with 63.7% meeting the needs, and 36.3% not meeting the needs, while for the Product Quality Test Facility data obtained 65.6% meet the adequacy and 34.4% do not meet the adequacy.

The availability of learning infrastructure in vocational education schools is the most important supporting factor that can affect the effectiveness of the learning model and the quality of graduates. From Figure 1, it can be seen that the learning infrastructure owned by vocational schools includes classrooms, principals' rooms, teachers' rooms, practice rooms, practical materials, and learning. In addition to the available space, there are various types of supporting facilities that are still not perfect in line with the growing scientific and technical needs of the business and industrial world. Security Facilities, Storage Facilities, Learning and Training Facilities. The availability of complete infrastructure is expected to support and increase the effectiveness of the learning model and produce high-quality graduates who can be accepted by the business world and industry. Practical learning in schools still lacks practical elements, making it difficult for students to understand and practice practical material. The high cost of acquiring this component causes schools to not have their own internship facilities.

4.3 Training Programs in Industry

The success and effectiveness of the implementation of vocational training programs is highly dependent on cooperation with industry. The collaboration between VET institutions and Business and Industry World (DUDI) generally aims to support the process of developing student work skills and training to produce graduates who meet industry demands. This collaboration will minimize competency gaps that cannot be filled in the training and further education process. Cooperation between VET institutions and the industrial world is carried out in various forms, including industrial employment practices, curriculum development and job fairs.

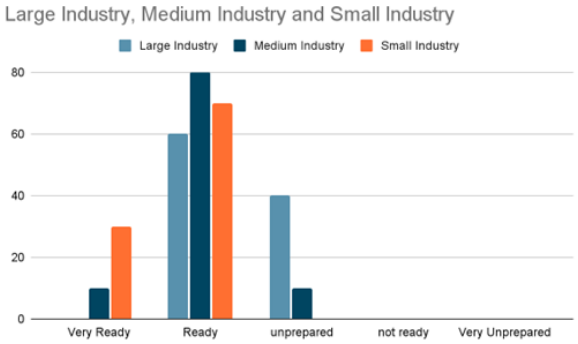

Figure 2. Graph of Industrial Readiness in terms of the Vocational School Student Training Program

Each large, medium, and small industry has 10 research objects. Based on the results of research conducted, industrial practice partners can be classified as ready. The overall level in the large Industrial Readiness category is 60% ready and 40% less ready. Medium industry states that readiness reaches 10% very ready, 80% ready, and 10% less ready. For small industries, 30% are very ready, 70% are ready and 0% are not ready. From several large industries that stated that they were not ready, there were several obstacles, namely: 1) the absence of an MoU (Cooperation Agreement) between Industry and Schools; 2) Unprepared industries come from private industries. Meanwhile, large industries that state that they are ready to implement industrial practices come from BUMN industries.

The vocational training system has long recognized and applied various concepts and forms of cooperation with companies and industries. However, cooperation between the two institutions is still not able to provide maximum benefits for both parties. In order for this collaboration to provide positive results in improving student skills and work competencies as well as training, several aspects need to be considered. This contributes to the creation of a quality workforce in the industrial sector. This situation is reflected in the number of vocational training institutions that have not succeeded in organizing an educational process that is in accordance with the world of work. This includes vocational high schools (SMK). The number of SMK graduates who are not accepted into the domestic labor market remains significant. This indicates the low level of trust and acceptance of the industry towards Indonesia's vocational training system.

In connection with this condition, GIZ through the SED-TVET (Sustainable Economic Development through Technical and Vocational Education and Training) program which is a cooperation program in the

field of vocational education and training between the Governments of Germany and Indonesia has carried out a comprehensive study on the theme of effective cooperation between institutions vocational training and Business and Industry World (DUDI). Through direct involvement of various stakeholders representing VET institutions, government and business and industry, this research aims to improve the quality and effectiveness of cooperation between VET institutions and industry. Utilization of these instruments will result in more effective collaboration between vocational training institutions and industry, and efforts will be made to produce vocational training graduates that meet industry needs.

4.4 Development of Virtual Reality in Learning and Training Programs in Vocational High Schools

One of the solutions carried out in order to meet the competence of students with limited facilities and equipment is to design interesting learning media, one of which is through virtual learning that can replace the role of the original training tool. Learning media must be able to carry out the simulation process in the training process. Therefore, with this training medium, any mistakes made by students during the practice process will not have an impact on the damage to existing components in the industry. The technology that can create the learning media is virtual reality.

Virtual reality is a technology that allows users to enter and interact with virtual worlds. Virtual reality is a computer-based technology that combines special input and output devices to allow users to interact deeply with a virtual environment [28]. Virtual reality-based training media can be used by students anytime, anywhere, enabling students to learn without the limitations of space and time. Because the media is used repeatedly and is a visual object, it does not damage the object. There have been many studies on the implementation of virtual reality technology as a learning medium [29]. Computer-designed virtual reality applications can play with box glasses and interact with virtual reality environments as if they were in the real world. This application has an attractive appearance and runs on smartphones with the Android operating system. Users must wear Google Cardboard or VR-box glasses.

Increased competence is influenced by the factor of sufficient training for vocational students. There was no special training carried out by schools, because in Vocational Schools everything was included with training. This means that learning in schools is training that is included in the curriculum, namely practical learning. Students are provided with a variety of programs that exist in vocational education in SMK. Provision of vocational training and skills.

Virtual reality is the result of technological developments that have unique advantages and are commonly applied in education and other scientific fields. The use of learning media in the form of virtual reality technology in education aims to increase information intake by students. For example, in the history of learning, learning tends to be boring, and in the field of science, it is difficult for students to convey the content just by listening to the teacher's lecture. The application of virtual reality technology in learning aims to improve student learning outcomes and motivation to learn. This paper presents the results of a research study demonstrating the effectiveness of using virtual reality on student learning outcomes and motivation. Table 1 below is a table of results for virtual reality development in learning and training programs.

Tabel 1. Development in Virtual Reality in Learning and Training Programs

Authors	Year	Country	Title	Technology		
				VR	AR	Hybrid
Hari Antoni Musril	2020	Bukit Tinggi, Sumatera	Implementation of Virtual Reality Technology in Computer Assembly Learning Media	√		
Dewa Made Yuda Andika	2022	Bali	adoption of technology in learning by using immersive technology in the form of virtual reality (VR)	√		
Afri Tri Fardani	2020	Malang, Jawa Timur	Use of Virtual Reality Technology for Junior High Schools in 2010-2020	√		
Andhika Bramantya	2020	Surakarta, Jawa Tengah	Development of Virtual Reality Technology in Computer Assembly Materials for Class X Vocational High School Students Computer Network Engineering	√		
Khoirul Imam Thohari	2018	Mojokerto, Jawa Timur	Application of Virtual Reality and Augmented Reality Technology in School Introduction Applications (Case Study: Dawarblandong National Smk)	√	√	

Authors	Year	Country	Title	Technology		
				VR	AR	Hybrid
Danang Dewantoro	2020	Jakarta	3D School Building Visualization with Android Based Virtual Reality Concept	√		
Muhammad Abid Darojat	2022	Malang, Jawa Timur	Development of Virtual Reality as a Learning Media for the Solar System	√		
Willy Permana Putra	2019	Indramayu, Jawa Barat	3D Virtual Reality Application Using Mobile-Based Unity as Environmental Introduction Media at SMK Negeri 1 Indramayu Use of Virtual Reality (Vr) Technology as an Effort	√		
Soni Ariatama	2021	Lampung, Kalimantan	Use of Virtual Reality (Vr) Technology as an Effort Escalation of Interest and Optimization in the Learning Process Online During a Pandemic	√		
Yoyon Efendi	2022	Riau, Kalimantan	3D Virtual Reality Workshop for Learning Creativity at SMK Sulthan Muazzam Syah	√		
Hendra Jaya	2022	Makassar, Sulawesi selatan	Potential Utilization of Virtual Reality for SMK teachers	√		

Figure 3. Distribution Pattern of Virtual Reality Development Areas in Vocational High Schools in Indonesia

Today's VR technology has the opportunity and potential to change the way students learn at every level. It's important to note that many factors beyond the technology itself determine the success of AR/VR solutions in educational environments. Policy makers need to act to create an environment in which innovation in this area can thrive.

Virtual reality is a new approach that allows users to interact in a computer simulation environment. This Virtual Reality technology is able to provide a new experience for its users and if it is combined with learning then the delivery of material will feel more fun

[30]. So far, Virtual Reality technology has been used in various education and industries as a medium for learning and training. The following is a list of companies in Indonesia that have implemented VR programs for training.

Table 2. List of Indonesian Companies that have implemented Virtual Reality Training

No	Company	Training Field
1	Loreal	OHS Modul (Occupational Health and Safety)
2	Toyota Motor Manufacturing Indonesia	The Toyota learning center creates a VR module related to identifying hazards in the workplace, thus work safety risks are minimized.
3	Telkom Corp	Technician training, beginning by demonstrating how to dress up the proper personal protective equipment (PPE) and completing with ODP installation

1. The first is to increase curiosity and enthusiasm for learning. VR creates three-dimensional visuals that visualize real-world objects without a live presentation. By creating a high curiosity, the high enthusiasm for learning also increases.
2. Second is to encourage students to think critically and creatively. Learning with VR technology makes the learning environment more interesting and imaginative, creating a new atmosphere and a modern impression while studying.
3. Third, Security risk. Before new recruits jump into physical locations, virtual reality can show real life even when they're actually in a physical location. Detecting, observing, identifying hazards early, and understanding hazardous areas in the workplace can reduce job risks when new employees are in real life.

4. Fourth is reducing costs, this is also reinforced by [31]. Training costs are not cheap. Because there will be a lot to prepare. Training costs, sometimes have to be imported directly from outside the city or even abroad because there are few experts. The cost of the training place, the rental of the training place is not cheap if the training is carried out with a large capacity of participants, because in general trainers must be brought in from far away, the capacity of new students gets most of it. Other material expenditures necessary for the smooth running of the training. VR can be created by dividing several modules from basic to advanced, with development, it can be used many times. So the coach doesn't have to go through all the steps for every training session.
5. Fifth is the process of effective knowledge transfer. Convey knowledge if what is conveyed can be understood correctly and quickly by new employees. When using VR, new employees will receive VR visual documentation/instructions, then they will be assessed directly, and finally the score data will be recorded as an evaluation [32].

VR provides scalable, repeatable and realistic training that helps employees learn information faster. Based on this data obtained regarding the response to the use of Virtual reality in practice and training activities in Figure 3.

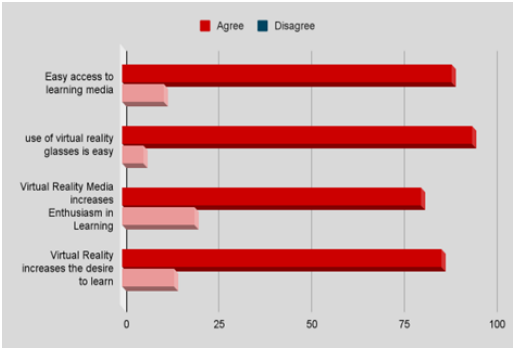

Figure 4. Response of VR Using by Learning and Training

Figure 5. Virtual Reality in Classroom Training

Student activities start from entering the training room then taking the provided place where training materials and training modules and training equipment have been prepared on the table to conducting training activities. It can be seen in Figure 4 that participants are carrying out the process of measuring the circuit through an oscilloscope measuring instrument.

Table 3. Participation of respondents in the training process results

Survey Content	Virtual Equipment (n=25)		Real Equipment (n=25)	
	Satisfied	Unsatisfied	Satisfied	Unsatisfied
Effective Utilization of Resources	72%	28%	24%	76%
Immersion and Real-Time Interaction	76%	24%	84%	16%
Improve The Aim and Interes	68%	32%	56%%	44%
Increase Initiative and Spirit of Participation	80%	20%	40%	20%

Statistical analysis of the limited data in Table 2 reveals that VR-based practicum exercises are more efficient in resource use, increase the goals and interests of trainees, and display other aspects, which are significantly higher than conventional practicums. national methods based on practice. However, there are some drawbacks in the simulation, compared to the real world.

5. CONCLUSION

The potential for developing virtual reality in vocational schools is said to have great opportunities based on the many applications of virtual learning and training applications implemented in vocational schools and their benefits in increasing curiosity and enthusiasm for learning, encouraging students to think critically and creatively, risk security, cost reduction, and practical knowledge transfer processes. This is evidenced by the participation of respondents in practical activities which show the effectiveness of resource utilization, immersion, and real-time interaction, increased interest, increased participation, and the effectiveness of practical exercises on average indicate that they enjoy using virtual equipment. when compared to real equipment.

AUTHORS' CONTRIBUTIONS

This paper consists of several author contributions, namely studies on the conception and Vocational Education: Hendra Jaya, data collection: Mantasia; analysis and interpretation of results: Sutarsi Suhaeb and Saharuddin; preparatory manuscript draft: Anita Candra Dewi; and Concept: Luther Pagiling.

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