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Comparison of Perceptions of High School Students Based on Class Levels on Utilization of Virtual Reality Laboratories

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Abstract— *This research is a descriptive quantitative research that aims to determine students' perceptions of the implementation of virtual reality (VR) laboratories. The population in this study were students of State Senior High Schools in Duren Sawit District, East Jakarta, with a random sampling technique of 200 students. Data collection techniques in this study used a questionnaire instrument with temporary understanding indicators, views, concerns with a total of 15 validated statement items. The validated perception questionnaire instrument was used in this study and then analyzed. The results of data analysis using a 3 x 2 manova with a significance level of 5% showed that there were differences in students' perceptions of the Virtual Reality (VR) Laboratory in terms of gender differences (sig. <0.05).*

Keyword: *Chemistry, students' perceptions, virtual reality, laboratories.*

I. INTRODUCTION

The chemistry learning system must be able to respond to competition for human resources according to the needs of the world of work. Chemistry learning in Indonesia still faces challenges, because students tend to perceive chemistry as a difficult and abstract lesson (Muderawan et al, 2019). This is caused by several things, one of which is that the method of delivering material by the teacher in front of the class is still conventional (Chen et al, 2020). Conventional learning should not be an option in the midst of world challenges in facing the industrial revolution 5.0 (Nahavandi, 2019). Indonesia was late in adapting to learning and implementing the 5.0 industrial revolution, where Japan as a country with high achievements in the world of education was the first country to implement the 5.0 industrial revolution (Fukuyama, 2018).

In 2016, Japan made the implementation of the 5.0 industrial revolution a growth strategy for Japan (Al Faruqi, 2019). Indonesia's growth is slower compared to Japan due to differences in curriculum and implementation as well as processes and evaluation (Wahyudin, 2004). The curriculum in Indonesia has recently changed to become an independent curriculum in response to the Covid 19 pandemic posing challenges in the educational aspect which resulted in Learning Loss (Jojor & Sihotang, 2022).

The demands of implementing the independent curriculum are that students are facilitated in assignments, practice, online learning, and mentoring (Alawi et al, 2022). In the implementation of the independent curriculum, as a new curriculum, the teacher must be able to know technological developments, the teacher must be able to implement the new curriculum, so the teacher must make a priority scale of work that must be completed immediately (Yulianti et al, 2022), this is to answer the efficiency of learning time while still paying attention to the demands of the industrial revolution 5.0 (Katona & Kovari, 2018).

Implementation of learning technology specifically in science learning is needed to improve the quality of learning. The quality of learning from the beginning to the end of learning must be the concern of education stakeholders (Felder & Brent, 1999). So far, learning has only focused on science as a product, not as a process and attitude (Sasmitatias & Kuswanto, 2018), because science learning will be complete if theory is proven through practicum (Schmidt et all, 2019).

Chemistry practicum requires a lot of money because the tools and materials are expensive (Pradibta & Nurhasan, 2020). To save on the use of consumable chemicals, a solution is needed to reduce the use of raw materials during practicum in the laboratory (Borisenko et all, 2019). In developing countries, the use of science laboratories, specifically chemistry subjects, has been replaced with virtual laboratories (Fung et al, 2019).

Virtual reality (VR) is also a solution to replace physical laboratories with various advantages and disadvantages. The advantages of VR are helping students connect theoretical and scientific concepts through science techniques and skills (Firmayanto et al, 2021), providing simulations that make students more involved in studying scientific phenomena, shortening the steps for preparing practicum activities, so that class time can be used effectively so that it allows students to repeat the experiment several times and meets the characteristics of teaching aids (Rohim, 2020). The downside

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of VR is that some of the important opportunities of experiential learning are not provided by virtual laboratories such as sensory engagement in learning (Franco Valdez & Valdez Cervantes, 2018). This is in line with research results which state that digital tools have value, these tools should not replace all physical laboratory activities (Scheckler, 2003; Ambusaidi et al, 2018).

Students' sensory abilities are one of the focuses of the problem of using virtual laboratories. Age differences lead to differences in human sensory abilities (Cohen et al, 1993). This is the focus of a teacher in designing chemistry lessons when utilizing a virtual laboratory. To strengthen the background above, it is necessary to obtain information from students with different age levels, which in this case is based on the levels of class X, XI, and XII senior high schools related to virtual laboratories.

II. METHODOLOGY OF RESEARCH

This research is a descriptive quantitative research, which was conducted to determine differences in students' perceptions regarding virtual laboratory reality when viewed from the class level, namely class X, XI and XI in the Department of Natural Sciences in Senior High Schools. The population of this study were high school students in Jakarta Bogor Depok Tangerang and Bekasi, and the sample was taken randomly (Atikan & Bala, 2017) with a total of 160 students consisting of 54 students in class X, 54 students in class XI and 52 students class XII students.

The data collection technique in this study used a perception questionnaire with 3 indicators, each indicator consisting of 5 statements by applying a Likert scale (Joshi et al, 2015), namely 1 was strongly disagree, 2 was disagree, 3 was undecided, 4 was agreed and 5 was totally agree as an option. The questionnaire instrument used was validated by an expert validator and revised to then be used as an appropriate instrument for research. The following in table 1 presents a grid of student perception questionnaire instruments that are valid and will be used in research:

Table 1. Student Perception Questionnaire Instrument

No	Indicator	Number of Question
1	Temporary Understanding	1, 2, 3, 4 and 5
2	Outlook	6,7, 8, 9 and 10
3	Concern	11, 12, 13, 14 and 15

The questionnaire instrument is presented on the Google form and distributed to respondents to obtain the data needed in this study. This research was carried out in three stages, namely planning, implementing and reporting with research procedures as presented in Figure 1 below:

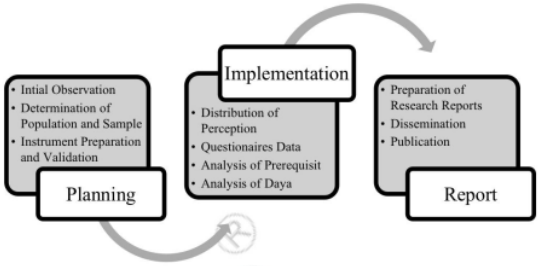

Fig 1. Procedure of Research

The description of the data obtained is presented in the form of a histogram to facilitate the delivery of information related to research data. The data obtained was first tested with prerequisite analysis, namely the homogeneity test with the Levene test. Further data analysis was carried out with Multiple Comparisons with ANOVA. Prerequisite analysis test and data analysis test were carried out at a significance level of 95% and analyzed using SPSS 24.

III. RESULTS AND DISCUSSION

Descriptively, the research data are presented in table 2 below:

Table 2. Data Description

Class	N	Mean	Std. Deviation	Minimum	Maximum
X	54	66.42	14.83	0.00	97.33
XI	54	66.57	12.36	20.00	94.67
XII	52	70.31	12.29	31.56	98.67
Total	160	66.83	13.17	0.00	98.67

Based on the data above, it can be seen that the difference in students' perceptions regarding the virtual reality laboratory is not significant. The difference in the average score of class X and XI is only 0.15, then the difference in the average score of class XI and XII is only 3.74 and the difference in the average score of class X and XII is only 3.89. Thus it was concluded that the higher the class level, the more positive the students' perceptions regarding the virtual reality laboratory. In line with research resultsby previous researchers who stated that independent learning practices through the use of technology for adult learners (Curran et al, 2019)

When viewed from each indicator, information on the perception scores of students in grades X, XI and XIII is obtained as presented in Figure 1 below:

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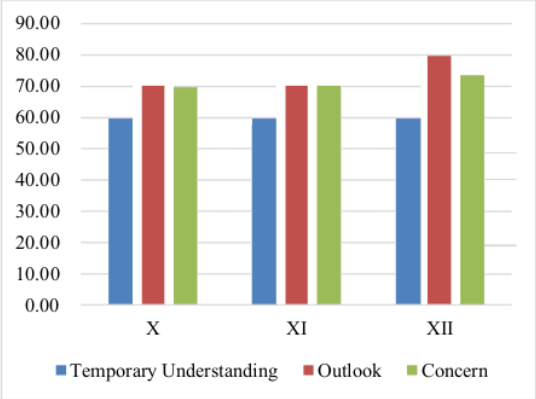

Fig 2. Student Perceptions by Each Indicator Based on Class Level to of Virtual Reality Laboratory

Student perceptions on the Outlook Indicator in all classes are the highest scores, meaning that on the Outlook indicator student perceptions are more positive than the Temporary Understanding and Concern indicators. When compared to the Outlook Indicator score, the average in class XII is higher. This is in line with the results of research, conclusing that demonstrating what must be learned helps students respond positively to learning (Frick et al, 2009).

The results of the research data analysis prerequisite test, namely the homogeneity test are presented in table 3 below:

Table 3. Homogeneity Test

Levene Statistic	df1	df2	Sig.
0.23	2	157	0.79

Based on table 3 above, it can be concluded that the variance is homogeneously distributed (sig > 0.05), namely 0.79.

The follow-up test in this study is the ANOVA test and then the Multiple Comparison test. The results of the ANOVA test are presented in table 4 below:

Table 4. ANOVA Test

Class	Mean Square	F	Sig.
X	66.42	0.342	0.711
XI	66.57	0.652	0.421
XII	70.31	0.649	0.422
Average	66.83	0.036	0.850

Based on the results of the ANOVA test above, it can be concluded that there is no significant difference between the perceptions of students in grades X, XI and XII high school (Sig > 0.05). However, when analyzed further, the mean score for each class level is different, although the difference is very small. This is possible because overall students in Indonesia are not familiar with VR technology (Suherdi et al, 2019) or have never used it directly or have not actively used virtual reality laboratories (Bima et al, 2021). Since 2019, the pandemic has required changes to the learning system and does not change the state of science learning in laboratories which are not actively carried out (Astuti, 2021).

Deepening the results of data analysis, a multiple comparisons test was carried out and the results were obtained as presented in table 5 below:

Table 5. Multiple Comparisons Test

Class	Class	Mean Difference	Std. Error	Sig.
X	XI	-.61722	2.55	0.97
	XII	-2.07464	2.57	0.70
XI	X	.61722	2.55	0.97
	XII	-1.45742	2.57	0.84
XII	X	2.07464	2.57	0.70
	XI	1.45742	2.57	0.84

Table 5 above shows a sig value > 0.05, thus it can be concluded that there is no significant difference between the perceptions of class X students towards class XI and class X students towards class XI, the perceptions of class XI students towards class X and class XI students towards class XII, the perceptions of class XII students towards class X and class XI students towards class XI.

These results are not in line with learning theory which states that ability (Hurst et al, 2012). More experience should be a provision to accept change, including changes to the learning system so that the perceptions of class XII students are naturally better than students of class X and XI (Schwartz et al, 2009).

IV. CONCLUSION

The conclusion from the results of this study is the difference in students' perceptions of virtual laboratory reality when viewed from the student level, namely class X, XI and XII high school, there is no significant difference. The average difference for each level, the highest is the average score of class X and XII, namely 3.89.

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