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Exploring the laboratory-based learning model to improve students' outcomes in the Learning for Autism course

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ABSTRACT

Many courses in higher education require real practice so that students can master the expected skills. Practice through lab-based learning is recommended. This research aims to determine the impact of laboratory-based learning on learning in autism learning courses. This research applies a quantitative research approach with a pre-experimental research design and a one-group pretest post-test design. The research involved twenty-five students taking part in laboratory learning over four meetings. The learning impact is measured from the pretest and posttest scores, which are analyzed non-parametrically using the Wilcoxon Test and a perception questionnaire regarding laboratory-based learning. The Wilcoxon test results show differences in the pretest and posttest results. This indicates that laboratory-based learning has an impact on student learning outcomes. Furthermore, the results of the questionnaire analysis showed that students enjoyed learning in the laboratory, and the majority felt that learning in the laboratory was useful, even though it required longer preparation. The results of this research can be a basis for developing laboratory-based learning models in other courses.

Keywords: laboratory-based learning, student's outcome, autism course

INTRODUCTION

Learning for students in higher education is challenging. In each course, students are required to achieve minimum standards in the knowledge, skill, and attitude aspects. Thus, to achieve these standards, lecturers need to plan lectures that align with learning objectives and follow current students' characteristics. In many literatures, the characteristics commonly shown by today's students are that they are fast in processing information, critical of the information presented, and need various examples and practice so that it is easy to understand it (Hernandez-de-Menendez et al., 2020). Learning models that are in line with these characteristics are generally student-centered. Some of these learning models include problem-based learning and project-based learning. These two models are commonly used in many lectures at universities in Indonesia. However, apart from the learning model, determining the appropriate learning method also needs to be considered, one of which is the laboratory-based learning method.

Educational laboratories (especially at universities) are academic support units that are used to carry out educational, research, and community service activities by using 1) equipment, 2) materials, and 3) based on certain scientific methods. The laboratory is one of the important supporting facilities, which is very strategic in the implementation of the education system, especially in the education system in higher education (Brockman et al.,

2020; Bugaj et al., 2019; Gamage et al., 2020). Its role and function is to carry out educational, research, and community service activities.

Effective education can optimally facilitate students' contribution to national development. Facilities and infrastructure are among the educational components that must be present in schooling. According to Barnawi and Arifin (2012), educational facilities include all equipment and supplies that directly support the educational process, while educational infrastructure consists of all equipment and supplies that indirectly support the educational process. Therefore, educational facilities and infrastructure must be present because they are very important to optimize teaching and learning activities.

Students will gain theoretical and practical knowledge by participating in the lecture process at the university. Both are important to do to provide concrete understanding to students. With a laboratory, we can verify the theory obtained with the actual reality (GrenobQiang et al., 2020). Many functions and benefits can be derived from using a laboratory. Therefore, to optimize the function of the laboratory, it needs to be managed well for the smooth running of the teaching and learning process and lectures.

Apart from that, there are several roles of educational laboratories, especially in the field of student skills, including (1) Training students to be skilled in carrying out technical skills practical activities for various sub-fields of skills, (2) Assembling and installing technical skills laboratory tools/equipment, (3) Carrying out experimental activities to check, test and research technical skills laboratory equipment, regulations, and standardization that have been made, (3) Form and design certain components in various expertise using technical skills laboratory facilities, (4) Serve students and the community in carrying out educational practices through technical skills laboratory tools as media, and (5) Maintaining and repairing technical skills laboratory tools/equipment. (Kusno, 2013)

In the special education study program (SE), there are six laboratories based on specialization. These laboratories include a blind laboratory, deaf laboratory, mentally retarded laboratory, quadriplegic laboratory, autism laboratory, and laboratory for children with learning disabilities. Each laboratory is specifically used for practice-based learning and early intervention courses.

Especially in the autism laboratory, 2022 renovations will be carried out, and additional facilities and infrastructure will be provided (figure 1). The renovation was carried out following the TEAACH learning model (Siu et al., 2019) recommended for autistic students. This laboratory, which applies the TEACCH learning model in the SE study program, is the first laboratory owned by a tertiary institution in Indonesia. Although not intensively, the TEACCH laboratory has been used in autism learning and early intervention courses. However, the effectiveness of laboratories in supporting learning outcomes is still unknown. This is essential to study as an improvement effort for autism laboratories. Therefore, it is necessary to examine the effectiveness of laboratory-based learning to determine student learning outcomes. Similar studies have been done before on the same topic (Gamage et al., 2020; Hudder et al., 2021], however, Therefore this research aims to produce laboratory-based learning tools in TEAACH topics and examine student learning outcomes in TEACCH topics through laboratory-based learning

METHOD

Research Design

This research applied a quantitative research approach with the type of pre-experimental research "retest Posttest Group Design" (Arikunto, 2010). This type of research was chosen because it can answer research questions regarding the impact and perception of lab-based learning. Furthermore, this research design was selected because of the limited number of students in the control group.

Research Steps

The research was carried out through the following steps:

a. Prepare learning tools for the Learning for Autistic Children course, TEACCH material, evaluation sheets for student understanding, and learning observation sheets for students.
b. We are coordinating with students.
c. Conduct initial tests.
d. Conduct learning for four meetings.
e. Conduct final tests
f. Perform data analysis.
g. Prepare research reports.

Research Subjects

The research involved 25 SE study program students from the autism specialization taking the Learning for Autistic Children course. Students will be given a brief explanation before the research will be carried out. The study also involved a lecturer teaching the Learning for Autistic Children course.

Data collection technique

Data was collected through test and questionnaire techniques. Data on improving students' cognitive abilities and skills will be collected through group performance tests using observation instruments. In contrast, data on students' perceptions of lab-based learning will be collected through questionnaires. There were four lessons during

Data analysis technique

The increase in students' cognitive abilities and skills was analyzed using descriptive statistics based on average, maximum, and minimum scores. The average score is obtained through the equation:

$$\bar{X} = \frac{\sum x_i}{N}$$

Testing the difference between the two averages between the initial and final tests uses the Wilcoxon Signed Test. The Wilcoxon test is a non-parametric test used to measure differences in 2 groups of paired data on an ordinal or interval scale, but the data is not normally distributed. This test is also known as the match pair test. The basis for decision-making in the Wilcoxon signed test is as follows:

a. When the probability value of Asym. Sig 2 failed <0.05; there is a difference in the average.
b. When the probability value of Asym. sig 2 fails > 0.05; then there is no difference in the average
c. Student responses to the application of laboratory-based learning were analyzed using the percentage formula:

RESULT AND DISCUSSION

Research on the effectiveness of laboratory-based learning in the Learning for Autistic Children course, TEACCH-based learning materials, was carried out through data collection and data analysis stages. Explanations for each research step are explained as follows:

The data collection process begins with giving an initial test/pretest in the second week of August 2023. In the initial test, students are asked to simulate TEACCH learning from material read directly in the laboratory. The initial test results of 25 students showed an average of 56.04, with detailed scores shown in Table 1.

Table 1. Initial Test Results

No	Initials	Mark
1	DARP	56
2	CL	60
3	ATA	56
4	NHI	45
5	YM	56
6	SWF	60
7	YES	65
8	ED	45
9	IDS	50
10	AAPF	68
11	YEAH	65
12	AMA	70
13	US	65
14	MM	56
15	YK	56
16	DAP	50
17	MM	45
18	SEM	45
19	RAM	50
20	ABR	56
21	AFS	50
22	RAR	56
23	FEN	70
24	FYN	56
25	FAM	50
Average		56.04

The data collection process continued with the implementation of TEACCH learning in the laboratory for four sessions until the middle of the second week of September 2023. In each session, the following activities were carried out:

a. The first session explained the four TEACCH principles and simulation with the lecturer.
b. Second session, practice by groups 1-2
c. Third session, practice in groups of 3-4.

d. In the fourth session, practice by group 5 and reflection.

The final process is conducting a final test/posttest and filling out a perception questionnaire regarding laboratory-based learning in the second week of September 2023. In the final test, students are again asked to simulate TEACCH learning from material read directly in the laboratory. The final test results for 25 students showed an average of 76.4, with detailed scores in Table 2. The results of the perception questionnaire are shown in Table 3.

Table 2. Initial Test Results

No	Initials	Mark
1	DARP	70
2	CL	85
3	ATA	70
4	NHI	73
5	YM	80
6	SWF	70
7	YES	70
8	ED	70
9	IDS	75
10	AAPF	80
11	YNAH	85
12	AMA	88
13	US	78
14	MM	70
15	YK	76
16	DAP	65
17	MM	70
18	SEM	70
19	RAM	78
20	ABR	80
21	AFS	86
22	RAR	80
23	FEN	88
24	FYN	75
25	FAM	78
Average		76.4

Table 3. Results of the Perception Questionnaire regarding Laboratory-Based Learning

No	Statement	5 Strongly agree	4 Agree	3 Neutral	2 DDon'tagree	1 Strongly Disagree
1	Laboratory-based learning is easy to implement	76%	24%	-	-	-
2	Laboratory-based learning supports the achievement of learning outcomes	80%	20%	-	-	-
3	Laboratory-based learning increases learning motivation	92%	8%	-	-	-
4	Laboratory-based	80%	20%	-	-	-

No	Statement	5 Strongly agree	4 Agree	3 Neutral	2 DDon'tagree	1 Strongly Disagree
	learning improves skills better					
5	Laboratory-based learning improves skills better than classroom learning	92%	8%	-	-	-
7	The learning facilities in the laboratory are adequate for learning TEACCH material	80%	20%	-	-	-
8	The learning infrastructure in the laboratory is adequate for learning TEACCH material	76%	24%	-	-	-
9	Learning in the laboratory requires a long preparation	92%	8%	-	-	-
10	Learning in the laboratory must be carried out for other materials	88%	8%	4%	-	-

The data collected in this research includes quantitative data through tests and perception questionnaires. The test result data was analyzed using the Wilcoxon Signed Test. The Wilcoxon test is a non-parametric test used to measure differences in 2 groups of paired data on an ordinal or interval scale, but the data is not normally distributed. The basis for decision-making in the Wilcoxon signed test is as follows:

a. When the probability value of Asym. Sig 2 failed <0.05; there is a difference in the average.
b. When the probability value of Asym. Sig 2 fails > 0.05; there is no difference in the average.

The results of the Wilcoxon Signed Test using the SPSS version 25 application show that Asym. sig 2 failed 0.000 (Figure 1]. Based on the results of this test, the probability value of Asym. sig 2 failed is <0.05 so it can be concluded that there is a difference in average. This difference shows the influence of laboratory-based learning on student learning outcomes.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The median of differences between PRETEST and POSTTEST equals 0.	Related-Samples Wilcoxon Signed Rank Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Figure 1. Wilcoxon Signed Test Results

The results of this study align with the results of several previous studies. Research by Biswas et al. (2021) shows that laboratory-based learning in Physics courses can improve student learning outcomes. Furthermore, in laboratory-based learning, students better understand the material being taught. Meanwhile, experimental research by Hudder et al. (2021) reported that students showed higher satisfaction and engagement in lectures in laboratory-based learning. Furthermore, research by Ballinas-Gonzales et al. (2022) and Buchori et al. (2021) shows that laboratory-based learning effectively develops student competencies, especially in fairly abstract material such as the material in this research.

Data from the questionnaire shows that all students showed an affirmative response that laboratory-based learning is easy to implement, supports the achievement of learning outcomes, increases learning motivation, and improves skills better (average n=> 75%). This condition follows previous research, which shows that laboratory-based learning can enhance learning outcomes and increase student involvement in learning (BucHudder et al., 2021; Buchori et al., 2021).

Furthermore, the perception questionnaire shows that adequate learning facilities and infrastructure are needed to support laboratory-based learning. Learning facilities and infrastructure are indeed core components in laboratories; it is hoped that these facilities and infrastructure also follow the characteristics of the learning material (Bottani et al., 2022). However, more than 90 percent of subjects said that learning in the laboratory required a long preparation period.

CONCLUSION

Research to determine the effectiveness of laboratory-based learning in Autism Learning courses with TEACCH material shows results following research assumptions. Students demonstrate an increase in learning outcomes when laboratory-based learning is implemented. The final test results showed a difference in the results of the initial test and final tests, with an increase in the average test result from 56.04 to 76.4. Students' perceptions of laboratory-based learning also show an average response of agreeing that laboratory-based learning is easy to implement and profitable.

These findings imply the importance of laboratory-based learning in supporting students' learning outcomes. In particular, courses which harness on the skills should be considered to spend more lessons in the laboratory. Moreover, future studies could investigate the same research questions but apply the real experiment study.

REFERENCES

Arifin Zainal. (2012). Learning Evaluation. Bandung: PT. Rosdakarya Remaja.

Ballinas-Gonzalez, R., Abella, R., Barrios, J., Garibay, R., & Garrido, J. (2022, March). A hydraulic 3D lab based on virtual Gora and visits at Call of Duty Warzone to Develop Competencies During the COVID-19 Pandemic. In 2022 IEEE Global Engineering Education Conference (EDUCON) (pp. 836-843). IEEE.

Biswas, MAR, Stilwell, B.L., & Reyes, E. (2021, March). Simulated Laboratory-Based Learning In A Thermal Fluid Laboratory Course. In ASEE 2021 Gulf-Southwest Annual Conference.

Bottani, E., Reverberi, D., Romagnoli, G., Ustenko, M., & Volpi, A. (2022). Batch experiment: A fruitful way of combining hands-on laboratory and e-learning. In Online Engineering and Society 4.0: Proceedings of the 18th International Conference on

Remote Engineering and Virtual Instrumentation (pp. 244-255). Springer International Publishing.

Brockman, R.M., Taylor, J.M., Segars, L.W., Selke, V., & Taylor, T.A. (2020). Student perceptions of online and in-person microbiology laboratory experiences in undergraduate medical education. Medical education online , 25(1), 1710324.

Buchori, A., & Pramasdyahsari, AS (2021). Implement virtual laboratory media to learn geometry in the mathematics education program of Universitas PGRI Semarang. International Journal of Research in Education (IJRE), 1(1), 41-50.

Bugaj, T.J., Blohm, M., Schmid, C., Koehl, N., Huber, J., Huhn, D., ... & Nikendei, C. (2019). Peer-assisted learning (PAL): skills lab tutors'experiences and motivation. BMC medical education , 19, 1-14.

Emha, H. (2002). Guidelines for Using School Laboratories . Bandung: PT Teen Roesda Karya.

Gamage, KA, Wijesuriya, DI, Ekanayake, SY, Rennie, AE, Lambert, CG, & Gunawardhana, N. (2020). Online teaching and laboratory practices delivery: Continuity of university programs during COVID-19 pandemic. Educational Sciences, 10(10), 291.

Grenoble, L. A., & Osipov, B. (2023). The dynamics of bilingualism in language shift ecology. Linguistic Approaches to Bilingualism , 13(1), 1-39.

Hernandez-de-Menendez, M., Escobar Díaz, C. A., & Morales-Menendez, R. (2020). Educational experiences

with Generation Z. International Journal on Interactive Design and Manufacturing (IJIDeM), 14, 847-859.

Hudder, K., Buck-McFadyen, E., Regts, M., & Bushuk, K. (2021). A quasi-experimental study comparing virtual simulation to lab-based learning of newborn assessment among nursing students. Clinical Simulation in Nursing , 55, 59-66.

Kusno. 2(013). Media and Laboratories: LABORATORY: Learning Technology Perspective. Yogyakarta: Faculty of Education.

Miarso, M. Sc., Prof. Dr. Yusufhadi. (2009). Sowing the Seeds of Educational Technology. Jakarta: KENCANA.

Siu, A. M., Lin, Z., & Chung, J. (2019). An evaluation of the TEACCH approach for teaching functional skills to adults with autism spectrum disorders and intellectual disabilities. Research in developmental disabilities, 90, 14-21.

Qiang, Z., Obando, A.G., Chen, Y., & Ye, C. (2020). Revisiting distance learning resources for undergraduate research and lab activities during the COVID-19 pandemic. Journal of Chemical Education, 97(9), 3446-3449.

Sukarno. (2005). Definition and Function of Laboratory. (Online http://wanmustafa.wordpress.com/2011/06/12/pengertian-dan-function-laboratorium/, accessed on March 30, 2023)