International Journal of Education, Information Technology and Others (IJEIT), December 2023, 6 (4), 120-126
DOI: https://doi.org/10.5281/zenodo.1044678
p-ISSN: 2654-2528 e-ISSN: 2623-2324
Accredited by Directorate General of Strengthening for Research and Development
Available online at https://jurnal.peneliti.net/index.php/IJEIT

Implementation Of Problem-Based Learning Strategies In Vocational Secondary Schools In The Field Of Technology And Engineering Skills

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Received: 9 October 2023
Revised: 26 October 2023
Accepted: 8 November 2023

Abstract

The research aims to determine the influence of learning strategies and Mathematics anxiety on learning outcomes in the PRE (PRE). The research was carried out at SMK Negeri 7 Bekasi City, West Java. Using experimental methods with a 2x2 factorial group design. The research sample consisted of 36 students selected randomly. The research results show that the PRE learning outcomes of students who use PBL learning strategies are higher than those who use direct learning strategies after controlling for Mathematics anxiety. There is an interaction effect between learning strategies and anxiety on students' PRE learning outcomes after controlling for Mathematics anxiety. The PRE learning outcomes of students who use PBL learning strategies for students who have high levels of Mathematics anxiety are higher than students who use direct learning strategies. The PRE learning outcomes of students who use PBL learning strategies for students who have low anxiety are lower than students who are taught using direct learning strategies. It can be concluded that there is an interaction effect between the use of learning strategies and Mathematics anxiety on PRE learning outcomes

Keywords: PBL strategy, direct instructions strategy, Penerapan Rangkaian Elektronika, SMK teknologi dan rekayasa.

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How to Cite: Setyowati, A., & Rusmono, R. (2023). Implementation Of Problem-Based Learning Strategies In Vocational Secondary Schools In The Field Of Technology And Engineering Skills. *International Journal of Education, Information Technology, and Others*, *6*(4), 120-126. https://doi.org/10.5281/zenodo.1044678

INTRODUCTION

Problem solving learning is generally considered to be important in developing students' thinking skills. However, this assumption ignores the fact that the problem solving process in the learning process does not always lead to the successful acquisition of problem solving skills for novice students (Van Merriënboer and Bruin 2013). In the 2013 national curriculum, junior and senior secondary education teachers, including Vocational High Schools (SMK), are required to design their learning with student-centred learning strategies, including Problem Based Learning (PBL) strategies. So far, the learning strategy used by vocational school teachers is a direct learning strategy. One of the characteristics of the PBL strategy is that learning is carried out through selfdirection (Hmelo & Lin, 2000; Loyens et al., 2008). Knowledge acquisition is always a product of independent learning with authentic problems according to the constructivist perspective (Leask & Younie, 2001). If learning is an active and constructive process, the role of students must becontribute to setting learning goals and strategies in knowledge construction activities. Learner self-direction is a prerequisite for learning but also a requirement for encouraging transfer. Selfdirection allows students to participate more actively in the learning process and take responsibility for their learning (Rieber, 1991). Especially in PBL strategies, independent learning can improve metacognitive skills and intrinsic motivation to further encourage students' efforts in understanding existing problem situations, organizing information, generating various solutions, and selfevaluation (Loyens et al., 2008). Meanwhile, according to Gersten (1984), direct learning strategies involve certain ways of teaching, designing the curriculum, implementing in-service education, and monitoring the performance of teachers and students. Furthermore, most researchers describe direct teaching as a process that breaks down the pedagogical task into several components. When teaching according to these components, instructors are able to demonstrate techniques efficiently to students as a combination of instructional components that results in an easier and more systematic learning process (Slavin. 2006; Stein, Silbert, & Camine, 1997; Watkins, 2003). Implementing PBL strategies in the learning process in vocational schools in the field of technology and engineering expertise is a challenge for teachers, because it requires professional development to obtain the necessary knowledge and skills. The question is, how is the performance of vocational school students in technology and engineering skills who study with PBL strategies compared to students who study with direct learning strategies? If the psychological factor of Mathematics Anxiety students is used as an attribute variable, is there an interaction between the use of learning strategies and Mathematics anxiety and the performance of vocational school students in the field of technology and engineering skills?

METHOD

This research uses an experimental research method with a 2x2 factorial group design. The choice of this method is adjusted to the expected data, namely differences in mathematics learning outcomes as a result of the treatment given. The dependent variable in this research is the performance of students in the PRE (PRE) Industrial Electronics Engineering Expertise Program at SMK technology and engineering. As an independent variable, the treatment is learning strategies, which are divided into two groups, namely PBL strategies as the experimental group and direct learning strategies as the control group. As an independent variable, the intervention in the form of an attribute variable is Mathematics anxiety, which is also divided into two groups, namely high levels of Mathematics anxiety and low levels of Mathematics anxiety.

RESULTS AND DISCUSSION

Result The results of calculating PRE learning outcomes for students majoring in electronics engineering at SMK Negeri 7 Bekasi City are shown in Table 1.

Table 1. Recapitulation of the results of calculating PRE learning outcomes for students majoring in electronics engineering at SMK Negeri 7 Bekasi City.

Strategy / Statistics	*PBL*	Direct Instructions (DI)	HMA	LMA	HMA with *PBL*	HMA with DI	LMA with *PBL*	LMA with DI
Mean	32,94	28,61	30,94	30,61	35,11	26,78	30,78	30,44
Standard Deviation	4,57	3,48	4,92	4,33	2,57	2,39	5,21	3,54
Mode	34,00	27,00	27,00	28,00	34,00	27,00	28,00	30,00
Median	34,00	28,50	30,50	30,00	36,00	27,00	29,00	30,00
Minimum Score	24,00	23,00	23,00	24,00	31,00	23,00	24,00	26,00
Maximum Score	39,00	38,00	39,00	39,00	39,00	30,00	39,00	38,00

Information:
HMA = High Math Anxiety
LMA = Low Math Anxiety

In Table 1, it appears that the average learning result for the PRE for students of the Electronics Engineering Department of SMK Negeri 7, Bekasi City, who studied with the PBL strategy was 32.94, with a minimum score of 24.00, and a maximum score of 39.00 . Meanwhile, the average learning result for PRE for Electronics Engineering students who studied using direct learning strategies was 28.61, with a minimum score of 23.00 and a maximum score of 38.00. The average score for the PRE learning outcomes for students majoring in Electronics Engineering, who study with PBL strategies and have a tendency towards High Mathematics Anxiety, is 35.11, with a minimum score of 31.00, and a maximum score of 39.00. The average score for learning outcomes for the PRE for students majoring in Electronics Engineering, who study with direct learning strategies and have a tendency towards High Mathematics Anxiety, is 26.78, with a minimum score of 23.00, and a maximum score of 30.00. The average score for learning outcomes for the PRE for students majoring in Electronics Engineering, who study with PBL strategies and have a tendency for Low Mathematics Anxiety, is 30.78, with a minimum score of 24.00, and a maximum score of 39.00. The average score for learning outcomes for the PRE for students of the Electronics Engineering Department, who study with direct learning strategies and have a tendency towards Low Mathematics Anxiety, is 30.44, with a minimum score of 26.00, and a maximum score of 38.00 The average score of learning outcomes for PRE for students who have a tendency to have high Mathematics anxiety who study with PBL strategies is 35.11, which is different from the average score for learning outcomes for PRE for students who have a tendency for high Mathematics anxiety who study with strategies. direct learning 26, 78. This means that there is a difference in the average score of learning outcomes for PRE between students who have a tendency to have high Mathematics anxiety who study with PBL strategies and students who have a tendency to have high Mathematics anxiety who study with direct learning strategies. Likewise, the average score for the PRE learning outcomes for students who have a tendency for low Mathematics anxiety who study with PBL strategies is 30.78, which is different from the average learning outcome for PRE for students who have a tendency for low Mathematics anxiety who study with direct learning strategy of 30, 44. It can be concluded that there are differences in learning outcomes between students who study with PBL learning strategies and students who study with direct learning strategies based on their level of Mathematics anxiety.

The results of the two-way ANOVA test for the PRE Learning Outcomes of Electronics Engineering Students at SMK Negeri 7 Bekasi City are shown in Table 2

Sumber Variansi	db	JK yres	RJK yres	Fo	Ftable (α = 0,05)
Instructional Strategy (A)	1	146,96	146,96	11,15	4,20
Math Anxiety (B)	1	2,15	2,15	0,16	4,20
Interaction (A'B)	1	151,53	151,53	11,50	4,20
Error	31	408,48	13,18	-	
Total Reduced	34	709,12		-	

In Table 2, it appears that the value of Fh = 11.50 is smaller than Ft = 4.20, meaning that there is a significant difference in learning outcomes for the PRE between students who study with the PBL strategy and students who study with the direct learning strategy. The value of Fh = 0.16 is smaller than Ft = 4.20, meaning that there is a significant difference in learning outcomes for PRE between students who have a tendency to have high mathematics anxiety and students who have a tendency to have low mathematics anxiety. The value of Fh = 11.50 is smaller than Ft = 4.20, meaning that there is an interaction between learning strategies and Mathematics anxiety.

DISCUSSION

Based on the results of data analysis, there are significant differences in learning outcomes for the PRE between students who study with the PBL strategy and students who study with the direct learning strategy. PRE learning with PBL strategies encourages students to solve problems independently (self-directed learning), so that knowledge acquisition is always a product of independent learning with authentic problems according to a constructivist perspective (Leask & Younie, 2001). One of the characteristics of problem-based learning is that learning is carried out through self-direction (Hmelo & Lin, 2000; Loyens et al., 2008). Meanwhile, the direct learning strategy places students in following the teacher's explanation, providing examples and exercises, and taking formative tests. Therefore, students who take part in direct learning are required to read repeatedly the material they will study in class. This is in line with the opinion of

Steventon and Fredrick (2003) that using direct learning strategies with specific programs has a positive effect on students who have undergone intervention by repeatedly reading the material to be studied in class. Judging from the level of Mathematics anxiety, there is also a significant difference in learning outcomes for PRE between students who study with the PBL strategy and students who study with the direct learning strategy. The subject of PRE is rational, objective and deductive. Rational, namely containing valid methods of proof, general formulas or rules or the systematic nature of mathematical reasoning. Objective, namely related to events that occur in everyday life. Deductive in nature, that is, a theory or statement in the PRE is accepted as true if it has been proven deductively. Students who have high mathematics anxiety have feelings of tension, fear of rejection, and stress (Truttschel, 2002). The level of Mathematics anxiety in students will interfere with their learning performance (Dredger and Aiken, 1957). When students solve problems the PRE is quite complex work which involves several aspects of problem solving, such as using information, knowledge of passive and active electronic components, the ability to calculate and use relationships between objects or abstractions. . This condition is in line with Häkkinen's view, PBL strategies encourage students to think critically and solve problems, interpersonal communication, information and media literacy, cooperation, leadership and teamwork, innovation and creativity (Häkkinen et al., 2017). It can be concluded that the high learning outcomes in the PRE for students who study with the PBL strategy are more due to the learning interactions created in the syntax of the PBL strategy. Meanwhile, learning outcomes for the PRE for students who study with a direct learning strategy are lower than students who study with a PBL strategy. This is more caused by learning interactions that are not created effectively, because students pay more attention to the teacher's explanations. Based on the results of hypothesis testing carried out, it is proven that there is an interaction between learning strategies and Mathematics anxiety in their influence on learning outcomes in the PRE. Groups of students who have high or low levels of Mathematics anxiety.

CONCLUSIONS

The results of research on students participating in the PRE subject with learning strategies as the treatment variable (or main variable (main effect), and students' Mathematics anxiety as a minor influence (simple effect), it appears that the average score for learning outcomes in the PRE is learning with the PBL strategy was 32.94, while the average score of learning outcomes for the PRE who studied with the direct learning strategy was 28.61. Based on these data, it can be concluded that there are differences in learning outcomes for the PRE between students who studied with the strategy PBL and students who learn with direct learning strategies. The results of the research are based on the influence of learning strategies by taking into account the level of Mathematics anxiety, it appears that the average score for the PRE learning outcomes for students who have a high level of Mathematics anxiety who study with the PBL strategy is 35.11 which is different from the average score for the Application of Learning outcomes. The Electronic Circuit of students who have a high level of Mathematics anxiety who study with a direct learning strategy is 26.78. The average score for the Application of Electronic Circuit learning outcomes of students who have a tendency of low Mathematics anxiety who study with the PBL strategy is 30.78 which is different from the average -The average learning result for the PRE for students who have a tendency to have low Mathematics anxiety who study with direct learning strategies is 30.44. Based on these data, it can be concluded that there is an interaction between the use of learning strategies and students' levels of Mathematics anxiety on learning outcomes in the PRE, Department of Electronics Engineering, State Vocational School 7, Bekasi City. Based on research conclusions, it has been proven that the effectiveness of implementing PBL learning strategies in the PRE subject. Meanwhile, PBL strategy assessment is more aimed at theory and skills. Therefore, research on the application of PBL strategies for practical subjects can be continued, so that it can be concluded that the effectiveness of PBL strategies for subjects that have more practical content in Vocational High Schools (SMK) in the field of technology and engineering skills.

REFERENCES

Bada, & Olusegun, S. (2015). Constructivism Learning Theory: A Paradigm for Teaching and Learning. IOSR Journal of Research & Method in Education,5(6),66-70. Retrieved from http://www.iosrjournals.org

Bajwa, H. & Mulcahy-Ernt, P. (2012). Redesigning Teaching Approaches for Undergraduate Engineering Classrooms. Integrated STEM Education Conference (ISEC), 2012 IEEE 2nd. doi:10.1109/ISECon.2012.6238558. Page(s): 1-4

Bruner, J. (1996). The Culture of Education, Cambridge, MA: Harvard University Press

Clark MC, Nguyen HT, Bray C, & Levine RE (2008). Team-based learning in an undergraduate nursing course. J Nurs Educ 47: pp.111-117.

Durik, A. M., Hulleman, C. S., & Harackiewicz, J. M. (2015). One size ts some: Instructional enhancements to pro- mote interest. Interest in Mathematics and Science Learn- ing, 49–62.

Fisher, R.(2007). Dialogic Teaching: Developing Thinking and Metacognition through Philosophical Discussion. Early Childhood development and Care, 177(7), 615-631. Retrieved from http://dx.doi.org/10.1080/03004430701378985.

Gersten. R. (1984) Direct instruction mathe- matics: A longitudinal evaluation of low-income elementary school students. The Elementary School Journal. 84(4), 395-407.

Greeno, J. G., Collins, A. M., & Resrick, L. (1996).Cognition and Learning. In R. C. Calfee & D. C. Berliner (Eds.), Handbook of Educational Psychology (pp. 15-46). New York:

Macmill Hmelo, C. E., & Lin, X. (2000). Becoming self-directed learn- ers: Strategy development in problem-based learning. Problem-Based Learning: A Research Perspective on Learn- ing Interactions, 227–250.

Hemlo-Silver, C.(2004). Problem Based Learning: What and How Do Students Learn? Educational Psychology Review, 16(3),235-266. Retrieved from https://doi.org/ 10.1023/B:EDPR. 0000034022.16470.f3.

Kelly, P. A., Haidet, P., Schneider, V., Searle, N., Seidel, C. L., & Richards, B. F. (2005). A comparison of in-class learner engagement across lecture, problem-based learning, and team learning us- ing the STROBE classroom observation tool. Teaching and Learning in Medicine: An Interna- tional Journal, 17(2), pp.112 - 118.

Leask, M., & Younie, S. (2001). Communal constructivist theory: Information and communications technology pedagogy and internationalisation of the curriculum. Journal of Information Techology for Teacher Education, 10(1–2), 117–134.

Loyens, S. M. M., Magda, J., & Rikers, R. M. J. P. (2008). Self-directed learning in problem-based learning and its relationships with self-regulated learning. Educa- tional Psychology Review, 20(4), 411–427. https://doi.org /10.1007/s10648-008-9082-7.

Mangal, S.K. (2008). Advanced educational psychology (2nd ed.). New Delhi: PHI Learning Private Limited.

McGarrity-DeShwan, N (2013). A Model for Developing Improvements to Critical Thinking Skills Across the Community College Curriculum University of Maryland University College, ProQuest, UMI Dissertations Publishing,

Rieber, L. P. (1991). E ects of visual grouping strategies of computer-animated presentations on selective attention in science. Educational Technology Research and Development, 39(4), 5– 15.

Renninger, K. A., & Hidi, S. (2015). e power of interest for motivation and engagement. New York, NY: Routledge. Sahin, M. (2007).The Importance of Efficiency in Active Learning. Turkish Science Education, pp. 65-69.

Sherno , D. J. (2013). Optimal learning environments to pro- mote student engagement. New York, NY: Springer.

Slavin. R. E. (2006).Educational psychology: Theory and practice (8th ed.). Pearson Education, Inc.

Snowman, J., & McCrown, R. (2012). Psychology applied to teaching. Wadsworth Cengage learning.

Stein, M.. Silbert, J., & Camine, D. (1997).Designing effective mathematics instruction: A direct instruction Approach (3rd ed.). Upper Saddle River. NJ.

Steventon. C. E., & Fredrick. L. D. (2OO3).The effects of repeated readings on student performance in the corrective reading program. Journal of Direct Instruction, 3(1), 17-27. Retrieved September 30.2007, from http://adi-home .org/articIes/JDI_03_01 _02 .pdf.

Walker, A., Leary, H., Hmelo-Silver, C., & Ertmer, P. (Eds.). (2015). Essential Readings in Problem-Based Learning: Exploring and Extending the Legacy of Howard S. Barrows.

Watkins, C. L. (2003).The components of direct instruction, you/««/ of Direct Instruction. 3(2), 75-110, Retrieved October 7, 2007, from http://adihome.org/artieles/JDr_03_02_01.pdf