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Problem-Based Learning Strategy Development in Vocational High School Field of Expertise Technology and Engineering in DKI Jakarta Province

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Abstract

The research aims to develop a PBL strategy for SMK in the field of technology and engineering expertise, by producing learning materials for applying electronic circuits with a PBL strategy. Using research and development methods, with the Dick and Carey model which consists of the design, development, and evaluation stages. At the design and development stage, materials for the application of Electronic Circuits with a PBL strategy are produced. At the evaluation stage, it is divided into 3 (three) stages, one on one evaluation by experts and by students; small group evaluation; and field trials. The results of the study materials for the Application of Electronic Circuits with the PBL strategy by instructional design experts and materials experts obtained an average of 87.12% and 88.44% with very decent predicates. The results of the one-to-one evaluation by students obtained 89.74%. Small group evaluation results obtained 94.28% of students can understand the characteristics of easy learning. The results of the field trial obtained 92.61%. Conclusion of learning materials for the Application of Electronic Circuits with a PBL strategy that is feasible to use.

Keywords: *PBL Strategy, SMK in the field of technology and engineering expertise, learning materials for applying electronic circuits*

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INTRODUCTION

Almost 80% of Vocational High School (SMK) teachers in Technology and Engineering in DKI Jakarta have good competence in implementing the Problem Based Learning (PBL) strategy, Rusmono and Wisnu (2020). PBL strategy as one of the learning strategies based on constructivism theory has facilitated the learning process of students to create effective teaching and learning interactions. PBL strategy is one of the problem solving learning models. Problem solving learning is generall considered as 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 learners (Van Merriënboer and Bruin 2013). Meanwhile, the constraint factors for implementing PBL strategie are lack of confidence in professional development; the notion that it is not important to implement a PBL strategy that can improve performance; and the absence of specific guidelines for PBL strategies (Rusmono, 2021). The question is, how to overcome the obstacles faced by vocational school teachers in the field of technology and engineering expertise in implementing PBL strategies? If we look at the 3 (three) obstacles faced by SMK teachers in implementing the PBL strategy, it appears that a special guidebook for the PBL strategy is needed. Through research and development, a PBL strategy Implementation Guidebook for Vocational High School teachers in the field of technology and engineering expertise will be produced. The research objective is the development of a PBL strategy in vocational technology and engineering expertise by producing a guideline for implementing the PBL strategy. The guidebook for implementing PBL strategies is intended for vocational school teachers in the field of technology and engineering expertise, especially in designing the learning of the subjects they teach. Research on the application of PBL learning strategies on the influence of PBL strategies on various internal factors of students, such as critical thinking skills, motivation, scaffolding, and STEM integration (Edy Suprapto et al., 2017; Kani Ulger, 2018; Huei-Chen L & Margaret R. B. , 2018; Nam Ju Kim et.al, 2019; Kathrine, L.T. & Diana, S., 2020; Abeera P. Rehmat & Kendall Hartley 2020; Yuli Ifana Sari et.al, 2021). Research on the application of PBL learning strategies on the effectiveness of PBL strategies in secondary education, improving business course learning outcomes, mathematics learning outcomes, improving language learning, and efficacy of employing (Peter A.J. Bouhuijs, 2011; Kristof De Witte & Nicky Rogge, 2012; Ruhban Maskur et al., 2013; Katherine B. Hartman et.al, 2013; Mohammed Abdullatif AlMulla, 2019; Samuel Bentil, 2019; Saleh Al-Busaidi et.al, 2021, Duong Huu Tong et.al, 2021).

RESEARCH METHOD

Research and development methods quoted from the book: The Systematic Design of Instruction by Dick, Walter., Carey, Lou., and Carey, James O. (2005), which was adapted as Steps of Systems Approach Model of Educational Research and Development by Gall, Meredith, D., Gall, Joyce, P. and Borg, Walter R. (2007:590), the entire instructional design process of Dick, Carey and Carey (2005) is fully adapted as a research and development model.

RESULT AND DISCUSSION

Result

The results of the formative evaluation by instructional design experts obtained an average score of 4.38 or 87.12%, which is shown in Table 1.

Table 1. Formative Evaluation Results of Instructional Design Experts

No.	Dimensions	Score	Percentage
1	Clrarity of Instruction	4,48	89,52
2	Impact on Learner	4,33	86,67
3	Feasibility of instruction	4,48	89,52
4	Centered on Instructional Objectives	4,43	86,50
5	Technical	4,18	83,33
	Score average	4,38	87,12

Based on the results of a formative evaluation by an instructional design expert on the draft learning materials for the Application of Electronic Circuits with the PBL Strategy it is very likely to be used in the learning process in technology and engineering Vocational Schools

Table 2. Results of Material Expert Formative Evaluation

No.	Dimensions	Score	Percentage
1	Clrarity of Instruction	4,47	89,33
2	Impact on Learner	4,38	87,56
3	Feasibility of instruction	4,38	87,56
4	Technical	4,47	89,33
	Score average	4,42	88,44

The results of the formative evaluation by material experts are in Table 2. the average is 4.42 or 88.44% very feasible. Based on the results of formative evaluation by material experts on the Implementation of Electronic Circuits with the PBL Strategy, it can be concluded that the learning materials for the Application of Electronic Circuits with the PBL Strategy are very suitable for use in the learning process in technology and engineering Vocational Schools. The average result of the one-to-one evaluation score (one-to-one by learner) by 3 PKM students on the draft Electronic Circuit Application Learning Material with the PBL strategy is 4.48 or 89.74%, students also understand the links between components basic messages (context, examples, analogies, illustrations, and demonstrations) compiled in the draft learning materials for the Application of Electronic Circuits with PBL strategy, it can be concluded that Learning Materials for Application of Electronic Circuits with PBL strategies can be easily understood by PKM students. The results of the average small group evaluation score by 8 PKM students on the draft learning material for the Application of Electronic Circuits with the PBL strategy were 4.71 or 94.28%, students could easily understand the characteristics of learning, namely the sequence, the size of the segments presented , transitions between segments, timing, and variations in data presentation. Students can also clearly understand the instructions and post-test items, as well as how to obtain post-test scores. It can be concluded that the Learning Materials for Application of Electronic Circuits with PBL strategies can be easily understood by PKM students.

Furthermore, the results of the field trials (field trials) as shown in Table 3. show an average score of 4.63 or 92.61%, it can be concluded that the Learning Material for the Application of Electronic Circuits with the PBL strategy can be easily understood by understanding the clarity of the instructions, and post-test items, as well as how to obtain post-test scores, thus forming attitudes (attitudes) of students regarding the relevance of information and skills how difficult/easy information and skills are learned, as well as satisfaction with the skills learned. The impact on students has the level of maturity, independence and motivation needed to complete learning according to the specified time. In other words, the learning material for the Application of Electronic Circuits with the PBL strategy is very similar to being used in the learning process in technology and engineering Vocational Schools, especially the Audio Video Engineering Skills Competency.

Table 3. Field Trial Results

No.	Indicators	Score	Percentage
1	The message (message) conveyed includes factors of vocabulary, complexity, sentences, and the structure of the message can be received clearly	4,68	93,69
2	Relationships (links) between the basic message components (context, examples, analogies, illustrations, and demonstrations) that are compiled can be understood clearly	4,68	93,69
3	Procedures regarding learning characteristics i.e. sequence, size of presented segments, transitions between segments, timing, and variations of data presentation are clearly understood	4,50	90,00
4	Attitudes (Attitudes) of students regarding the relevance of information and skills how difficult/easy the information and skills are learned, as well as satisfaction with the skills learned	4,50	90,00
5	Student achievements in learning through post-tests include clarity of instructions, and post-test items, as well as how to obtain post-test scores	4,72	94,33
6	Students have the level of maturity, independence and motivation needed to complete learning according to the allotted time	4,72	94,33
7	The resources needed for learning the Application of Electronic Circuits with a PBL strategy, include time, equipment, and instructional environment	4,61	92,25
	Score average	4,63	92,61

Discussion

Based on the results of the study, it appears that almost all dimensions in formative evaluation according to instructional design experts in learning materials Application of Electronic Circuits with PBL strategies appear clear and appropriate for learning, including clarity on the relevance of general learning objectives and specific learning objectives, the relevance of learning objectives to tests, and relevance learning objectives with learning strategies, so it is very feasible to be used in the learning process in technology and engineering Vocational Schools, especially in the competence of Audio Video Engineering expertise. The results of the material expert evaluation showed that 88.44% of students had the level of maturity, independence and motivation needed to complete learning according to the allotted time, and technically the stages of group assignments were easy for students to understand with clear access to information sources in PBL sheets. This is in line with the view of most researchers that PBL strategies have four basic characteristics, namely: focusing on complex real-world problems that do not have one correct solution, students work in groups, students obtain new information through independent learning, and the teacher acts as a facilitator. (Boud & Feletti, 1997; Hmelo-Silver, 2004; 2015; Savery, 2015).

The results of a one-to-one by learner evaluation of 3 PKM students showed that 89.74% of students could clearly understand vocabulary, sentence complexity and message structure in learning materials for Application of Electronic Circuits with PBL strategies. Students also understand the links between basic message components (context, examples, analogies, illustrations, and demonstrations), PBL strategies have a philosophical and epistemological foundation based on an integrated learning approach that is firmly rooted in John Dewey's educational theory, constructivist philosophy (McCaughan , 2015), and psychological theory (Hmelo-Silver, 2015).

The results of the small group evaluation of 8 students showed that 94.28% of students could easily understand the characteristics of learning, namely sequence, size of the segments presented, transitions between segments, time, and variations in data presentation. Students can also clearly understand the instructions and post-test items, as well as how to obtain post-test scores.

However, problem solving requires teachers to provide regular feedback to assess achievement of learning objectives (Chan, 2016; Grob, Holmeier, & Labudde, 2017). This creates workload challenges in PBL, especially when compared to well-structured problems that have predetermined answers.

The results of the field trial evaluation of 10 PKM students obtained 92.61% of students easily understanding the clarity of instructions, and post-test items, as well as how to obtain posttest scores, thereby forming student attitudes regarding the relevance of information and skills how difficult/easy information and skills are learned , as well as satisfaction with the skills learned. The impact on students has the level of maturity, independence and motivation needed to complete learning according to the specified time. This fits with the core of the PBL strategy to gain a deeper understanding of the relationship between the building process of cognitive development and the social construction of knowledge across contexts and over time (Green & Bridges, 2018).

CONCLUSION

The PBL strategy for technology and engineering Vocational Schools refers to the development of learning materials with the PBL strategy within the technology and engineering Vocational Schools, competence in Audio Video Engineering expertise. The development uses the Walter Dick and Lou Carey (2015) model with the stages: design, development, and evaluation. The results of the design and development stages are in the form of learning materials for the Application of Electronic Circuits with the PBL strategy. The formative evaluation stage is divided into three, namely: one-to-one by expert and by learner; small group evaluations; and field trials.

The results of one-to-one by experts, namely instructional design experts and material experts, obtained an average of 87.12% and 88.44% with a very feasible predicate, meaning that in terms of instructional design and materials, learning materials Application of Electronic Circuits with strategies PBL is very suitable for use in the learning process in the technology and engineering Vocational School environment, competence in Audio Video Engineering expertise. The results of one-to-one by learner for 3 students obtained 89.74%, meaning that students easily understand the contents of learning materials for Application of Electronic Circuits with PBL strategies. The results of the small group evaluation of 8 students obtained 94.28%, meaning that students can easily understand the characteristics of learning, namely the order, the size of the segments presented, the transitions between segments, the time, and variations in data presentation, as well as the clarity of instructions and post-test items, and how to get a posttest score. While the results of the field trial to 10 students, obtained 92.61%, meaning that there is a formation of student attitudes regarding the relevance of information and skills, how difficult/easy information and skills are learned, and satisfaction with the skills learned.

Based on the conclusions of the research, specifically for teachers of technology and engineering vocational competence in Audio Video Engineering, who do not yet have the confidence and motivation to implement PBL strategies in their subjects, learning materials for Application of Electronic Circuits with PBL strategies can assist teachers in developing Implementation Plans Learning (RPP) and development of learning materials. In order to facilitate the application of learning materials using the PBL strategy, the management of SMKs should facilitate teachers in the form of workshops.tegi *PBL*, kiranya pihak Manajemen SMK perlu memfasilitasi guru-guru dalam bentuk workshop

BIBLIOGRAPHY

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.

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

Chan, C. K. Y. (2016). Facilitators' perspectives of the fac- tors that a ect the e ectiveness of problem-based learning process. *Innovations in Education and Teaching International,*

53(1)

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

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

Green, J. L., & Bridges, S. M. (2018). Interactional ethnog- raphy. In F. Fischer, C. E. Hmelo-Silver, S. R. Goldman, & P. Reimann (Eds.), *International handbook of the learning sciences* (pp. 475–488). New York, NY: Routledge.

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

Grob, R., Holmeier, M., & Labudde, P. (2017). Formative assessment to support students' competences in inquiry- based science education. *Interdisciplinary Journal of Problembased Learning, 11*(2)

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.

Hmelo-Silver, C. (Ed.) (2015). e process and structure of problem-based learning. In A. Walker, H. Leary, C. Hmelo-Silver, & P. Ertmer (Eds.), *Essential readings in problem-based learning: Exploring and extending the leg- acy of Howard S. Barrows* (pp. 1-3). West Lafayette, IN: Purdue University Press.

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.

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

McCaughan, K. (2015). eoretical anchors for Barrow's PBL tutor guidelines. In A. Walker, H.

Leary, C. Hmelo-Silver, & P. Ertmer (Eds.), *Essential readings in problem-based learning: Exploring and extending the legacy of Howard S. Barrows* (pp. 57-68). West Lafayette, IN: Purdue Univer- sity Press.

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,

Sahin, M. (2007).The Importance of Efficiency in Active Learning. Turkish Science Education, pp. 65-69.

Savery, J. (2015). Overview of problem-based learning: De nitions and distinctions. In A. Walker, H. Leary, C. Hmelo-Silver, & P. Ertmer (Eds.), *Essential readings in problem-based learning: Exploring and extending the leg- acy of Howard S. Barrows* (pp. 5-15). West Lafayette, IN: Purdue University Press.

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

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*.