Model *Project Based Learning* (PjBL) yang Disisipi Multirepresentasi Dinamik untuk Meningkatkan Keterampilan Berpikir Kreatif dan *Engineering Design Behaviour* Siswa SMK

Tesis

Diajukan untuk memenuhi sebagian syarat untuk memperoleh gelar

Magister Pendidikan Fisika

Disusun oleh:

Roni Permana 1707251

PROGRAM STUDI

PENDIDIKAN FISIKA

SEKOLAH PASCASARJANA

UNIVERSITAS PENDIDIKAN INDONESIA

2020

Model *Project Based Learning* (PjBL) yang Disisipi Multirepresentasi Dinamik untuk Meningkatkan Keterampilan Berpikir Kreatif dan *Engineering Design Behaviour* Siswa SMK

Oleh

Roni Permana

Sebuah Tesis yang diajukan untuk memenuhi salah satu syarat memperoleh gelar Magister Pendidikan (M.Pd.) pada Program Studi Pendidikan Fisika

Universitas Pendidikan Indonesia

Januari 2020

HALAMAN PENGESAHAN TESIS

Roni Permana

1707251

Model *Project Based Learning* (PjBL) yang Disisipi Multirepresentasi Dinamik untuk Meningkatkan Keterampilan Berpikir Kreatif dan *Engineering Design Behaviour* Siswa SMK

Disetujui dan Disahkan oleh :

Pembimbing I

Prof. Dr. Parlindungan Sinaga, M.Si.
NIP. 19620426 198703 1 002

Pembimbing II

Dr. Didi Teguh Chandra, M.Si.
NIP. 19591013198431001

Mengetahui
Ketua Program Studi Pendidikan Fisika
Sekolah Pascasarjana Universitas Pendidikan Indonesia

Dr. Taufik Ramlan Ramalis, M.Si.
NIP.195904011986011001

Model *Project Based Learning* (PjBL) yang Disisipi Multirepresentasi Dinamik untuk Meningkatkan Keterampilan Berpikir Kreatif dan *Engineering Design Behaviour* Siswa SMK

Roni Permana

ABSTRAK

Penelitian ini bertujuan untuk menganalisi peningkatan keterampilan berpikir kreatif dan *engineering design behaviour* siswa SMK dengan model *Project Based Learning* (PjBL) yang Disisipi Multirepresentasi Dinamik. Metode penelitian yang digunakan dalam penelitian ini adalah kuantitatif dengan bentuk rancangan *quasi-exsperiment research*. Desain penelitian yang digunakan berupa *pretest-posttest control group design*. Subjek penelitian ini terdiri dari 52 siswa kelas XI sekelah menengak kejuruan. Instrumen yang digunakan dalam penelitian ini adalah tes esai 3 soal yang terdiri dari pertanyaan keterampilan kreatif dan *engineering design behaviour* dianalisis *normalized gain* (<g>) kelompok eksperimen dan kontrol. Untuk menganalisis perbedaan peningkatan antar variabel digunakan analisis statistik parametrik Uji t' (*Independet Sample Test*), non-parametrik *Mann-Whitney U Test* dan Uji *Effect Size*. Hasil analisis menunjukan bahwa model PjBL yang disisipi multirepresentasi dinamik memiliki peningkatan yang lebih tinggi dan terbukti efektif dibandingkan model PjBL tanpa disisipi multirepresentasi dinamik.

Kata Kunci: Model *Project Based Learning*, Keterampilan Berpikir Kreatif, *Engineering Design Behaviour*, Multirepresentasi Dinamik

Model *Project Based Learning* (PjBL) yang Disisipi Multirepresentasi Dinamik untuk Meningkatkan Keterampilan Berpikir Kreatif dan *Engineering Design Behaviour* Siswa SMK

Roni Permana

ABSTRACT

This research purposes to analyze the improvement of creative thinking skills and engineering design behavior of vocational students with the Project Based Learning (PjBL) model which is Inserted by Dynamic Multirepresentations. The research method used in this research is quantitative in the form of a quasi-experimental research design. The research design used was a pretest-posttest control group design. The subjects of this study consisted of 52 students of grade XI while looking up vocational. The instrument used in this study was a 3 question essay test consisting of questions of creative skills and engineering design behavior analyzed normalized gain (<g>) of the experimental and control groups. To analyze the difference between variables increases the statistical analysis of the t test (Independent Sample Test), non-parametric Mann-Whitney U Test and Effect Size Test is used. The results of the analysis show that the PjBL model inserted by dynamic multi-representation has a higher increase and is proven effective compared to the PjBL model without the insertion of dynamic multi-representation.

Keywords: Project Based Learning Model, Creative Thinking Skills, Engineering Design Behavior, Dynamic Multi-representation

DAFTAR ISI

Halaman

DAFTAR PUSTAKA

Abidin, Y. (2016). Revitalisasi penilaian pembelajaran. Bandung: Refika Aditama.

Adadan, E., Irving, K. E., & Trundle, K. C. (2009) International Journal of Science Impacts of Multirepresentational Instruction on High School Students' Conceptual Understandings of the Particulate Nature of Matter, (August 2013), 37–41.

Adi, N. P., & Kurniawan, Y. (2018). Meningkatkan higher order thinking skill dan sikap terbuka melalui media pembelajaran android. *Journal of Komodo Science Education*, *1*(01), 79-94.

Ainsworth, S. (1999). The functions of multiple representations, 33, 131–152.

Ainsworth, S., & VanLabeke, N. (2004). Multiple forms of dynamic representation. *Learning and instruction*, *14*(3), 241-255.

Amabile, T. M. (1989). *Growing up creative: Nurturing a lifetime of creativity*. Crown House Publishing Limited.

Anderson, L.W. & Krathwohl, D.R. (2010). Kerangka Landasan untuk Pembelajaran, Pengajaran, dan Asesmen. Yogyakarta: Pustaka Pelajar

Antika, R. N., & Nawawi, S. (2017). The effect of project based learning model in seminar course to student's creative thinking skills. Jurnal Pendidikan Biologi Indonesia, 3(1), 72-79.

Anwar, D. F. T., Mahardika, I. K., & Supeno, S. (2017). Characteristics of Physics Module about Mechanics-Based on Multi Representation to Improve Students of Senior High School Reasoning Ability. Jurnal Pancaran Pendidikan, 6(3).

Arikunto, S. (2009). Dasar-dasar Evaluasi Pendidikan. Jakarta: Bumi Aksara.

Asunda, P. A., & Hill, R. B. (2007). Critical features of Engineering Design in Technology Education. Journal of Industrial Teacher Education, 44(1), 25-48.

Ayesh, A., Qamhieh, N., Tit, N., & Abdelfattah, F. (2010). The effect of student use of the free-body diagram representation on their performance. Educational Research, 1(10), 505-511.

Baker, W. (2001). Gender and bilinguals' creativity. World Englishes, 20(3), 321-339.

Bao, L., & Redish, E. F. (2006). Model analysis: Representing and assessing the dynamics of student learning. Journal Physical Review Special Topics-Physics Education Research, 2(1), 010103.

Baran, M., Maskan, A., & Yasar, S. (2018). Learning Physics through Project-Based Learning Game Techniques. International Journal of Instruction, 11(2), 221-234.

Becker, Lee A., (2000). Effect Size Measures for Two Independent Groups. (Effect Size, 2000), hlm, 3

Benedek, M. (2018). 10 Internally Directed Attention in Creative Cognition. The Cambridge handbook of the neuroscience of creativity, 180.

Berbasis, I., Elasti, M., Permata, A., Feranie, S., & Karim, S. (2016). Penerapan Pembelajaran Berbasis Masalah dengan Pendekatan Multirepresentasi untuk Meningkatkan Prestasi Belajar dan Konsistensi Ilmiah Berbasis Multirepresentasi pada Materi Elastisitas,

Bétrancourt, M., & Tversky, B. (2000). Effect of computer animation on users' performance: a review/ (Effet de l'animation sur les performances des utilisateurs: une sythèse). Journal Le travail humain, 63(4), 311.

Blumenfeld, P. C., Soloway, E., Marx, R. W., Krajcik, J. S., Guzdial, M., Palincsar, A. Palincsar, A. (2011). Motivating Project-Based Learning: Sustaining the Doing, Supporting the Learning Motivating Project-Based Learning: Sustaining the Doing, Supporting the Learning, 1520.

Boss, S., & Krauss, J. (2014). Reinventing project-based learning: Your field guide to real-world projects in the digital age. International Journal Society for Technology in Education.

Brookhart, M. A., Schneeweiss, S., Avorn, J., Bradbury, B. D., Liu, J., & Winkelmayer, W. C. (2010). Comparative mortality risk of anemia management practices in incident hemodialysis patients. Jama, 303(9), 857-864.

Busyairi, A., & Sinaga, P. (2015). Strategi pembelajaran creative problem solving (CPS) berbasis eksperimen untuk meningkatkan kemampuan kognitif dan keterampilan berpikir kreatif. Jurnal pengajaran MIPA, 20(2), 133-143.

Cahyani, R., Rustaman, N. Y., Arifin, M., & Hendriani, Y. (2014). Kemampuan kognisi, kerja ilmiah dan sikap mahasiswa non IPA melalui pembelajaran inkuiri berbantuan multimedia. Jurnal Pendidikan IPA Indonesia, 3(1).

Capraro, R. M., Capraro, M. M., & Morgan, J. R. (Eds.). (2013). STEM project-based learning: An integrated science, technology, engineering, and mathematics (STEM) approach. Springer Science & Business Media.

Carin, A. A., & Sund, R. B. (1970). Teaching science through discovery. CE Merrill Publishing Company.

Carni, C. (2016). Implementasi Pendekatan Icare (Introduction, Connection, Application, Reflection, Extension) Untuk Meningkatkan Pemahaman Konsep Dan Keterampilan Berpikir Kreatif Materi Listrik Dinamis (Doctoral dissertation, Universitas Pendidikan Indonesia).

ChanLin, L. J. (2008). Technology integration applied to project-based learning in science. Journal Innovations in education and teaching international, 45(1), 55-65.

Clark, P. M., & Mirels, H. L. (1970). Fluency as A Pervasive Element in The Measurement of Creativity 1. Journal of Educational Measurement, 7(2), 83-86.

Cohen, L., Manion, L., & Morrison, K. (2002). Research methods in education. routledge.

Coughlan, T., & Johnson, P. (2008). An exploration of constraints and end user development in environments for creative tasks. Intl. Journal of Human–Computer Interaction, 24(5), 444-459.
Crismond, D. P., & Adams, R. S. (2012). The informed design teaching and learning matrix. Journal of Engineering Education, 101(4), 738-797.
Dado, M., & Bodemer, D. (2017). A review of methodological applications of social network analysis in computer-supported collaborative learning. Educational Research Review, 22, 159-180.
De Cock, M. (2012). Representation use and strategy choice in physics problem solving. Physical Review Special Topics-Physics
De Jong, T., & Ferguson-Hessler, M. G. M. (1986). Cognitive Structures of Good and Poor Novice Problem Solvers in Physics. Journal of Educational Psychology, 78(4), 279–288.
DelRosario, R., Petersen, P. F., Keys, L. K., & Chen, I. J. (2004). Concurrent Engineering for the management of research and development. 2004 IEEE International Engineering Management Conference: Managing Technologically-Driven Organizations; November 01, 2003 - November 03, 2003; Albany, NY; United States
Denayer, I., Thaels, K., Sloten, J. V., & Gobin, R. (2003). Teaching a structured approach to the design process for undergraduate engineering students by problem-based education. European journal of engineering education, 28(2), 203-214.
Djupanda, H., Kendek, Y., & Darmadi, I. W. (2015). Analisis Keterampilan Berpikir Kreatif Siswa SMA dalam Memecahkan Masalah Fisika. JPFT (Jurnal Pendidikan Fisika Tadulako Online), 3(2), 29-34.
Doppelt, Y. (2009). Assessing creative thinking in design-based learning. International Journal of Technology and Design Education, 19(1), 55-65.
Dutson, A. J., Todd, R. H., Magleby, S. P., & Sorensen, C. D. (1997). A review of literature on teaching engineering design through project-oriented capstone courses. Journal of Engineering Education, 86(1), 17-28.
Dyer, J. H., Gregersen, H. B., & Christensen, C. (2008). Entrepreneur behaviors, opportunity recognition, and the origins of innovative ventures. Strategic Entrepreneurship Journal, 2(4), 317-338.
Dym, C. L., Agogino, A. M., Eris, O., Frey, D. D., & Leifer, L. J. (2005). Engineering design thinking, teaching, and learning. Journal of engineering education, 94(1), 103-120.
Eragamreddy, N. (2013). Teaching creative thinking skills. International Journal of English Language & Translation Studies, 1(2), 124-145.
Eragamreddy, N. (2013). Teaching creative thinking skills. International Journal of English Language & Translation Studies, 1(2), 124-145.
Erdem, A. R., & Adiguzel, D. C. (2019). The Opinions of Primary School Teachers on their Creative Thinking Skills. Eurasian Journal of Educational Research, 19(80), 25-38.
Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2011). How to design and evaluate research in education. New York: McGraw-Hill Humanities/Social Sciences/Languages.

Frank, M., Lavy, I., & Elata, D. (2003). Implementing the project-based learning approach in an academic engineering course. International Journal of Technology and Design Education, 13(3), 273-288.
Grant, M. M. (2011). Learning, beliefs, and products: Students' perspectives with project-based learning. Interdisciplinary Journal of Problem-Based Learning, 5(2), 6.
Guilford, J. P. (1967). Creativity: Yesterday, today and tomorrow. The Journal of Creative Behavior, 1(1), 3-14.
Gültekin, M. (2005). The Effect of Project Based Learning on Learning Outcomes in the 5th Grade Social Studies Course in Primary Education. Journal Educational Sciences: Theory & Practice, 5(2).
Gustiani, I. (2016). Learning Science Through Stem Base Instructional Material: Its Effectiveness in Improving Students Conceptual Understanding and Its Effect Towards Engineering Design Behaviors and Teamwork Skills (Doctoral dissertation, Universitas Pendidikan Indonesia).
Haik, Y., Sivaloganathan, S., & Shahin, T. M. (2018). Engineering design process. Nelson Education.
Hake, R. R. (1999). Analyzing change/gain scores. Unpublished. [online] URL: http://www. physics. indiana. edu/~ sdi/AnalyzingChange-Gain. pdf.
Harry, A. R. (2018,). Pembelajaran Berbasis Proyek (Project Based Learning) untuk Meningkatkan Keaktifan Belajar Siswa. In Prosiding Seminar Nasional Matematika dan Pendidikan Matematika (SNMPM) (Vol. 2, No. 1, pp. 43-48).
Howard, T. J., Culley, S. J., & Dekoninck, E. (2008). Describing the creative design process by the integration of engineering design and cognitive psychology literature. Design Studies, 29(2), 160–180.
Hu, W., & Adey, P. (2002). A scientific creativity test for secondary school students. International Journal of Science Education, 24(4), 389-403.
Hwang, Y., & Kim, D. J. (2007). Customer self-service systems: The effects of perceived Web quality with service contents on enjoyment, anxiety, and e-trust. Decision support systems, 43(3), 746-760.
Inati, H. D., Abidin, Z., & Junaedi, E. (2016). Penerapan Model Pembelajaran Inquiry Training Berbantu Vee Diagram Terhadap Keterampilan Berpikir Kreatif Siswa Kelas X Pada Konsep Ekosistem. Quagga: Jurnal Pendidikan dan Biologi, 8(2).
Isabekov, A., & Sadyrova, G. (2018). Project-Based Learning to Develop Creative Abilities in Students, 43–49.
Jatmoko, D. (2013). Relevansi kurikulum SMK kompetensi keahlian teknik kendaraan ringan terhadap kebutuhan dunia industri di Kabupaten Sleman. Jurnal Pendidikan Vokasi, 3(1).
Jou, M., Chuang, C. P., & Wu, Y. S. (2010). Creating Interactive Web-Based Environments to Scaffold Creative Reasoning and Meaningful Learning: From Physics to Products. Turkish Online Journal of Educational Technology-TOJET, 9(4), 49-57.
Kemdikbud. (2014). Materi pelatihan guru implementasi kurikulum 2013 tahun ajaran 2014/2015: Mata pelajaran IPA SMP/MTs. Jakarta: Kementerian Pendidikan dan Kebudayaan.

Kizkapan, O., & Bektas, O. (2017). The Effect of Project Based Learning on Seventh Grade Students' Academic Achievement. International Journal of Instruction, 10(1), 37-54.
Klieger, A., & Sherman, G. (2015). Physics textbooks: do they promote or inhibit students' creative thinking. Journal Physics Education, 50(3), 305.
Kohl, P. B., & Finkelstein, N. D. (2006). Effects of representation on students solving physics problems: A fine-grained characterization. Physical review special topics - Physics education research, 2(1), 010106.
Kozielska, M. (2004). Developing creativity of students in a computer-assisted learning process. European journal of physics, 25(2), 279.
Lau, S., & Cheung, P. C. (2010). Creativity assessment: Comparability of the electronic and paper-and-pencil versions of the Wallach–Kogan Creativity Tests. Thinking Skills and Creativity, 5(3), 101-107.
Lenz, I., Lee, H., & Saxena, A. (2015). Deep learning for detecting robotic grasps. The International Journal of Robotics Research, 34(4-5), 705-724.
Li, Y., Huang, Z., Jiang, M., & Chang, T. W. (2016). The Effect on Pupils' Science Performance and Problem-Solving Ability through Lego: An Engineering Design-based Modeling Approach. Journal of Educational Technology & Society, 19(3).
Mahardika, I. K. (2013). Characteristic of Mechanics Teaching Materials for Increasing Students of Physics Teacher Candidates Representation Ability on Verbal, Mathematical, Picture, and Graphic. Jurnal Pengajaran MIPA, 18(2), 214-220.
Mariah, S., & Sugandi, M. (2010). Kesenjangan soft skills lulusan SMK dengan kebutuhan tenaga kerja di industri. Kesenjangan Soft Skills Lulusan Smk Dengan Kebutuhan Tenaga Kerja Di Industri. Jurnal Pendidikan Teknologi dan Kejuruan, 22(4), 385-310.
Masany, A. M., Mukhadis, A., & Sutikno, T. A. (2014). Implementasi Kurikulum Tingkat Satuan Pendidikan Spektrum Smk Pada Program Studi Keahlian Teknik Komputer Dan Informatika. Teknologi Kejuruan: Jurnal Teknologi, Kejuruan, dan Pengajarannya, 37(1).
Maslow, A. H. (1967). Synanon and eupsychia. Journal of Humanistic Psychology, 7(1), 28-35.
Mihardi, S., Harahap, M. B., & Sani, R. A. (2013). The effect of project based learning model with kwl worksheet on student creative thinking process in physics problems. Journal of Education and Practice, 4(25), 188-200.
Mills, J. E., & Treagust, D. F. (2003). Engineering education—Is problem-based or project-based learning the answer. Australasian journal of engineering education, 3(2), 2-16.
Mulyadi, E. (2015). Penerapan Model Project Based Learning untuk Meningkatan Kinerja dan Prestasi Belajar Fisika Siswa SMK. Jurnal Pendidikan Teknologi dan Kejuruan, 22(4), 385-395.
Munandar, U. (2004). Memupuk Bakat dan Kreativitas Siswa Sekolah Menengah. Jakarta: PT. Gramedia.
Mustofa, M. H. (2016). Penerapan Pendekatan Entrepreneural Science Thinking (Escit) Melalui Model Project Based Learning Untuk Meningkatkan Kemampuan Memahami Dan Keterampilan Berpikir Kreatif Siswa Sma

Pada Materi Listrik Dinamis (Doctoral dissertation, Universitas Pendidikan Indonesia).
NGSS Lead States. (2013). Next generation science standards: For states, by states. Washington, DC: The National Academy Press
Nusbaum, E. C., & Silvia, P. J. (2011). Are intelligence and creativity really so different?: Fluid intelligence, executive processes, and strategy use in divergent thinking. Journal Intelligence, 39(1), 36-45.
Oam, S. D. B., Cathcart, M., & Peach, N. (2018). Work based learning as a conduit to business creativity in Australia Work based learning as a Conduit to Business Creativity in Australia, (October).
Palmer, S. E. (1978). Fundamental Aspects of Cognitive Representation. In E. Rosch (Ed.), Cognition and categorization (pp. 259-303).
Patriot, E. A., Suhandi, A., & Chandra, D. T. (2017). Effect of Implementation Interactive Conceptual Instruction with Multi Representation Approach to Improve Levels of Understanding on Work and Energy Subject Matter. 4Th ICRIEMS Proceedings.
Perrenet, J. C., Bouhuijs, P. A. J., & Smits, J. G. M. M. (2000). The suitability of problem-based learning for engineering education: theory and practice. Teaching in higher education, International Journal of Education 5(3), 345-358.
Prahani, B. K., Limatahu, I., Winata, S. W., Yuanita, L., & Nur, M. (2016). Effectiveness of physics learning material through guided inquiry model to improve student's problem solving skills based on multiple representation. International Journal of Education and Research, 4(12), 231-244.
Prain, V., Tytler, R., & Peterson, S. (2009). Multiple representation in learning about evaporation. International Journal of Science Education, 31(6), 787-808.
Putri, N. (2019). Penerapan Challenge Based Learning (CBL) Melalui Pendekatan STEM (Science Technology Engineering and Mathematics) Dalam Pembelajaran Listrik Dinamis Untuk Meningkatkan Keterampilan Berpikir Kreatif Siswa (Doctoral dissertation, Universitas Pendidikan Indonesia).
Rahmazatullaili, R., Zubainur, C. M., & Munzir, S. (2017). Kemampuan berpikir kreatif dan pemecahan masalah siswa melalui penerapan model project based learning. Beta: Jurnal Tadris Matematika, 10(2), 166-183.
Railsback, J. (2002). Project-Based Instruction: Creating Excitement for Learning. By Request Series. American Journal of Educational Research. 2017, Vol. 5 No. 5, 559-563
Rosengrant, D., Etkina, E., & Heuvelen, A. Van. (2005). An Overview of Recent Research on Multiple Representations *, 10–13.
Rosnia, I., Suwarma, I. R., & Hikmat, H. (2018). Menggali Engineering Design Behaviour (EDB) Siswa SMP dalam Membuat Solusi Krisis Energi dalam Pembelajaran STEM. In Seminar Nasional Fisika (Vol. 4, No. 1, pp. 97-101).
Rumini, Sri, dan Siti Sundari. 2004. Perkembangan Anak dan Remaja. Jakarta: PT Rineka Cipta.

Runco, M. A. (2007). Achievement sometimes requires creativity. High Ability Studies, 18(1), 75-77.
Seechaliao, T. (2017). Instructional Strategies to Support Creativity and Innovation in Education. Journal of Education and Learning, 6(4), 201.
Shamblin, M, (2012). Creative Problem Solving. Cleveland State University
Siswanto, J. (2018). Keefektifan Pembelajaran Fisika dengan Pendekatan STEM untuk Meningkatkan Kreativitas Mahasiswa. Jurnal Penelitian Pembelajaran Fisika, 9(2), 133–137.
Solso, R. L., MacLin, M. K., & MacLin, O. H. (2005). Cognitive psychology. Pearson Education New Zealand.
Sri Rumini & Siti Sundari. (2004). Perkembanga Anak & Remaja. Jakarta: Rineka Cipta
Srikoon, S., Bunterm, T., Nethanomsak, T., & Tang, K. N. (2018). Effect of 5P model on academic achievement, creative thinking, and research characteristics. Kasetsart Journal of Social Sciences, 39(3), 488-495.
Sujati, H. (2005). Menganalisis Kualitas Tes Sebagai Salah Satu Kompetensi Guru Profesional. Jurnal Ilmiah Guru Caraka Olah Pikir Edukatif, 9(01).
Sulaiman, S., & Sari, D. S. (2017). Efektivitas Kemampuan Menulis Mahasiswa Menggunakan Numbered Heads Together Dilihat Dari Kreativitas Mahasiswa. Edukasi: Jurnal Pendidikan, 15(1), 128-141.
Sumarni, W. (2018). The Influence of Ethnoscience-Based Learning On Chemistry to The Chemistry's Literacy Rate of the Prospective Teachers. Unnes Science Education Journal, 7(2).
Tamba, Motlan, Turnip, (2017). The Effect of Project Based Learning Model for Students' Creative Thinking Skills and Problem Solving. IOSR Journal of Research & Method in Education (IOSR-JRME). PP 67-70
Tamba, P., Motlan, Turnip. B.M., (2017). The Effect of Project Based Learning Model for Students'Creative Thinking Skills and Problem Solving. IOSR Journal of Research & Method in Education. PP 67-70.
The George Lucas Educational Foundation. (2005). Instructional Module Project Based Learning. Diambil pada tanggal 10 Desember 2019 dari http://www.edutopia.org/modules/PBL/whatpbl.php
Thomas, J.W. (2000). A Review of Research on Project Based Learning. California: The Autodesk Foundation.
Tolinia, S. (2019). Penerapan Strategi Pembelajaran Creative Problem Solving Untuk Meningkatkan Keterampilan Berpikir Kreatif Siswa Dalam Pemecahan Masalah SMA Daerah 3T Pada Materi Listrik Dinamis (Doctoral dissertation, Universitas Pendidikan Indonesia).
Torrance, E. P. (1984). The role of creativity in identification of the gifted and talented. Gifted Child Quarterly, 28(4), 153-156.
Treagust, D., Chittleborough, G., & Mamiala, T. (2003). The role of submicroscopic and symbolic representations in chemical explanations. International Journal of Science Education, 25(11), 1353-1368.
Trnova, E., & Trna, J. (2014). Implementation of creativity in science teacher training. International Journal on New Trends in Education and Their Implications, 5(3), 54-63.

Utami, M. (2002). Kreativitas dan keberbakatan. Jakarta: PT Gramedia Pustaka Utama.

Uziak, J. (2016). A project-based learning approach in an engineering curriculum. Global Journal of Engineering Education, 18(2), 119-123.

Wang, C. W., & Horng, R. Y. (2002). The effects of creative problem solving training on creativity, cognitive type and R&D performance. R&D Management, 32(1), 35-45.

Wang, C. W., Wu, J. J., & Horng, R. Y. (1999). Creative thinking ability, cognitive type and R&D performance. R&D Management, 29(3), 247-254.

Wijayati, N., Sumarni, W., & Supanti, S. (2019). Improving student creative thinking skills through project based learning. KnE Social Sciences, 408-421.

Yusro, A. C. (2017). Pengembangan Perangkat Pembelajaran Fisika Berbasis SETS Untuk Meningkatkan Kemampuan Berpikir Kreatif Siswa. Jurnal Pendidikan Fisika dan Keilmuan (JPFK), 1(2), 61-66.

Zhou, C. (2012). Integrating creativity training into problem and project-based learning curriculum in engineering education. *European Journal of Engineering Education*, *37*(5), 488-49