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Development Of B-Pro Detect (Brainstorming, Problem Identification, Prototype Design, Try, Conflict Evaluation) Learning Model to Increase Creative Thinking and Learning Results of SMP/MTs Students

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ABSTRACT

Education has undergone significant changes in modern times. Students are experiencing a decline in their thinking skills, particularly in the areas of creativity and critical thinking. This is due to the monotonous nature of their learning, which has resulted in less developed thinking patterns. The EDP model aims to improve creative problem-solving skills, equip students with the ability to overcome difficulties through careful planning, and encourage learning through failure. This study describes the B-ProDe TEct (Brainstorming, Problem Solving, Design Prototype, Try, Evaluate of Conflicts) learning model, which integrates Brain-Based Learning (BBL) principles into Engineering Design Process (EDP). The model has been demonstrated to enhance creative thinking skills and improve science learning outcomes in junior high school students. The study utilizes a mixed methods research approach, combining both quantitative and qualitative methods. This approach enables a more comprehensive analysis of the research question. The practicality scores from each school, derived from the feasibility test, were 87.08%, 83.25%, and 86.67% respectively, resulting in an overall average of 85.67%. The study evaluated the effectiveness of the B-Pro DeTEct learning model on a group of 30 students. The N-gain was 0.37 at the third session and 0.55 at the fourth session, with an average N-gain of 0.46. These results suggest a moderate increase in cognitive learning outcomes before and after using the model. The study concludes that the model is valid, practical, and successful in enhancing creative thinking skills.

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1. INTRODUCTION

Rapid technological advances have made 21st century learning a student-centred era, giving individuals the freedom to find their own learning materials (Afni et al., 2021). The current educational environment enables students to access learning resources with greater ease. Rapid technological advancements have led to the emergence of 21st century learning, which is a student-centred era where individuals are given the freedom to seek out their own learning materials (Afni et al., 2021). The implementation of a significant learning process within the context of 21st century learning brings about a transformation in the series of lessons. It is important to note that 21st century learning comprises a variety of competencies and cannot exist in isolation. To achieve the assessment standards, curriculum, teaching, professional development, and the learning environment, a support system is required (Chu et al., 2017). Therefore, in order to confront the challenges of the 21st century, pupils must possess the 4C proficiencies: critical thinking, effective communication, collaborative skills, and innovative capabilities (Jefferson & Anderson, 2017). It is imperative to exercise them, as the artistic pondering abilities of students, primarily in Indonesia, have diminished. Questionnaires distributed to teachers in 13 schools indicate that 70% of teachers believe students' creative thinking skills need improvement. To address this issue, one approach is to employ EDP and BBL learning models that are both enjoyable for students and motivating for teachers.

Brain-Based Learning (BBL) is a student-centric methodology that purportedly benefits instructors in enhancing pupils' cognitive formations and assisting their learning (Thomas & Swamy, 2014). The data from a

study conducted in Turkey on BBL-based instruction in science education indicate that it is mostly based on academic achievements and attitudes, hence enhancing academic performance and promoting positive attitudes towards science education (Yaşar, 2017). Shabatat (2016) utilised the effect size of eta squared, which demonstrated that BBL-based methods of teaching can account for approximately 80% of the variance in student achievement, while the remaining 20% is attributed to other factors. Shabatat and Al-Tarawaneh (2016) have observed an improvement in levels of achievement within the experimental group through the implementation of BBL, in comparison to the control group (Shabatat & Al-Tarawneh, 2016). Therefore, it can be inferred that BBL-based education enhances the brain's ability to facilitate students through maximising emotional, social, physical and reflective learning (Sesmiarni, 2016).

The Engineering Design Process (EDP) Learning Model is credited with fostering creative problem-solving skills, equipping students with the ability to tackle problems through meticulous planning, and promoting learning from failure (Hill-Cunnngham, et al., 2018). EDP was proposed by multiple researchers as a solution to challenges experienced in STEM-focused academic settings. The aim of EDP is to foster students' critical and creative thinking skills and problem-solving abilities through solutions and prototyping (Aini and Aini). This study refines the EDP learning model by incorporating the principles of Brain-Based Learning (BBL) to create a more concise engineering design process based on BBL. Brain-Based Learning (BBL) is a pedagogical approach that aligns with the functioning of the brain. It utilizes strategies designed for effective learning and engagement based on principles derived from understanding the brain. BBL-based learning is highly effective in optimizing student learning outcomes by enhancing emotional, social, physical, and reflective learning (Sesmiarni, 2016). This learning method provides a comfortable and non-intimidating experience for students. It promotes a sense of relaxation (Shabatat & Al-Tarawneh, 2016).

The connection between the EDP model and BBL necessitates that student comprehend scientific and social occurrences in their milieu in an enjoyable manner, and can advance creative thinking abilities among students. Given the aforementioned background, a study was executed titled "Development of the B-Pro DeTEct Learning Model (Brainstorming, Problem Solving, Design Prototype, Try, Evaluate of Conflicts) to Improve Creative Thinking of Junior/MTs Students".

2. RESEARCH METHOD

The chosen research methodology is mixed methods research. According to Creswell (2014), mixed methods research is an approach that incorporates quantitative and qualitative data to provide a comprehensive understanding in addressing research questions. This approach produces research outcomes that offer a more in-depth comprehension of the complex phenomena under investigation. A research methodology that combines both quantitative and qualitative methods can yield more comprehensive, valid, reliable, and objective data when used together in a research activity (Sugiyono, 2018). Data collection in this study involved several techniques, including observation, interviews, and pretest-posttest. The implementation involved a small class test with 10 students, a large class with a minimum of 25 students, and two classes in different schools.

The study focused on the development of the B-Pro DeTEct learning model, with participants being eighth-grade students in junior high schools / MTs. The research took place during the odd semester of 2022/2023 and the study of the B-Pro DeTEct model will be carried out in November of the same academic year. The research took place in various junior high schools / MTs located in Banyuwangi Regency and Jember Regency. The data analysis technique used in learning development research involves validating the data obtained from the results obtained by validators, assessing the validity of the learning implementation questionnaire completed by both students and teachers, and assessing the effectiveness of the creative thinking skills demonstrated in the students' learning outcomes. Effectiveness is measured by the n gain value.

Validation using analysis with the following formula:

$$\mathbf{V} = \frac{TSE}{TSM} \boldsymbol{x}\ \mathbf{100\%}$$

(Akbar, 2013)

Description:
V: Percentage of assessment level
TSE: Total empirical score
TSM: Total maximum score

The percentage data obtained is then converted using the assessment category Table 2.1

Table 2.1 Validation Assessment Categories

No	Persentase (%)	Category	Description
1.	82 < x ≤ 100	Very valid	Product is ready to be utilized in the field (school) for learning
2.	63 < x ≤ 81	Valid	The product can be continued with the note of adding something that is missing as long as the addition is not large and not something fundamental
3.	43 < x ≤ 62	Less valid	The product must go through revision by carefully re-examining and reviewing its weaknesses in an effort to improve the product.
4.	25 < x ≤ 42	Not valid	Product content must undergo major and fundamental revisions

The practicability was analyzed using the following formula

Percentage of Implementation = N/NM x 100%

(Adapted from Retnowati, 2015).

Description:
N : Total score obtained
NM : Total score (maximum)

The percentage data that has been obtained is then converted using the assessment categories in Table 1.2

Table 2.2 Category of Learning Implementation

No	Persentase (%)	Category
1.	82 < x ≤ 100	Very Practical
2.	63 < x ≤ 81	Practical
3.	44 < x ≤ 62	Less Practical
4.	25 < x ≤ 43	Not Practical

(Hake, 2016).

The efficacy was evaluated through the n-gain equation by considering the learners' achievements in the creativity aptitude assessments.

$$\textit{Normalized gain (g)} = \frac{\textit{posttest value pretest value}}{100-\textit{value pretest}}$$

The value scale used in the normalised gain data is then categorised in Table 1.3

Table 2.3 Gain Category Table

Score	Category
normalized gain ≥ 0,7	High
0,3 < normalized gain < 0,7	Medium
normalized gain < 0,3	Low

3. RESULT AND DISCUSSION

The B-Pro DeTEct learning model is a collaborative learning model of the Engineering Process Design method with a Brain Based Learning approach. The B-Pro DeTEct model has been designed to provide a fun learning model for students and teachers to motivate students to learn and think creatively. Several researchers proposed Engineering Process Design (EDP) to overcome challenges in STEM-based learning. EDP promotes critical and creative thinking, problem-solving skills, and solution prototyping (Hynes, et al., 2011). Brain-based Learning (BBL) is a learning approach that synchronises the natural design of both brain hemispheres. The aim of this academic model is to guide students towards meaningful learning, rather than mere memorisation (Junaedi & Lestari, 2017).

The Table 3.1 provides a description of the B-Pro DeTEct Learning Model Validation Instrument (Braisntorming, Problem Solving, Prototype Design, Try, Evaluate of Conflict) validity. The data on the learning model's validity are obtained through the completion of the validation instrument validity assessment sheet by two expert validators and one user validator.

Table 3.1 The results of the validity test of the B-Pro DeTEct learning model validation instrument

No	Assessment Items	Score (%)			Average (%)	Category
		V1	V2	V3		
1.	Statement is in accordance with the instrument syntax	75	100	75	83,3	Very Valid
2.	Based on the content or material aspects, the instrument can reveal the weaknesses of the B-Pro DeTEct learning model so that it supports improvement	100	100	75	91,6	Very Valid
3.	Based on the overall appearance aspect, the instrument can reveal the overall quality of the B-Pro DeTEct learning model so that it allows for improvement	75	100	75	83,3	Very Valid
4.	Based on the development aspect, the instrument can reveal the quality of the presentation of the learning model and reveal the weakness of the presentation so that it allows for presentation suggestions	75	100	75	83,3	Very Valid
	Average Assessment Percentage	81,25	100	75	85,41	Very Valid
	Category	Very Valid	Very Valid	Valid	Very Valid	

Table 3.1 illustrates the mean percentage evaluation of the B-Pro DeTEct teaching model validation tool's validity. The evaluators' assessments resulted in 81.25%, 100% and 75%, with a total average percentage of 85.41% for the validity assessment. Accordingly, the validation tool for the B-Pro DeTEct learning model is highly valid for utilisation. The validity test results for the B-Pro DeTEct learning model, derived from the completion of a validity assessment by two expert validators and one user validator, are presented in Table 3.2. The table outlines the Syntactic, Social System, Reaction Principles, Support System, Instructional Impact, and Accompanying Impact components. Technical terms are explained in full when first used.

Table 3.2 Results of the validity test of the B-ProDeTEct learning model

No	Assessment Item	Score (%)			Mean	Category
		V1	V2	V3		
1.	Syntax	87,5	93,75	87,5	98,58	Very good
2.	Social System	87,5	91,66	83,33	86,10	Very good
3.	Reaction Principle	75	100	87,5	83,33	Very good
4.	Support System	91,66	91,66	83,33	88,88	Very good
5.	Instructional Impact	75	75	75	75	Good
6.	Accompanying Impact	75	75	75	75	Good
	Average Assessment Percentage	83,92	91,07	83,93	86,30	Very good

Table 3.2 illustrates the mean validity assessment percentage of the B-Pro DeTEct learning model. The results from each validator were 83.92%, 91.07% and 83.92%, culminating in total validity of 86.3%. These findings confirm the high validity of the developed B-Pro DeTEct learning model, rendering it highly suitable for application. The effectiveness of the model is evidenced by the n-gain results of student learning outcomes. Technical terms are defined upon first use throughout the text. Table 3.3 presents quantitative data on student

cognitive learning outcomes resulting from the administration of pre-test and post-test sheets to students during the limited large group trial stage.

Table 3.3 N-Gain Results of Student Learning Outcomes

Meeting	Number of Students	Means Score		Difference	*N-Gain*	Category
		Pre-Test	Pos-Test			
P2	30	42,67	64,30	10,82	0,37	Middle
P3	30	52,33	77	24,67	0,55	Middle
Score Average		47,5	70,65	17,75	0,46	Middle

Table 3.3 presents the N-Gain outcomes of the cognitive learning of students from the large group trial. Analysis of the assessment data from 30 students revealed that the N-Gain value was 0.37 at the third meeting and 0.55 at the fourth meeting, with an average N-Gain value of 0.46. According to these outcomes, the B-Pro DeTEct learning model resulted in a moderate improvement in students' cognitive learning outcomes before and after the application of the learning model.

The results of research into the soundness, practicality and effectiveness of the B-Pro DeTEct (Brainstorming, Problem Solving, Design Prototype, Try, Evacuate of Conflicts) learning approach developed. The title is precise and factual, and the language is clear, objective and free from bias, slang or colloquialisms. The content follows conventional academic structure, using logical progression and causal links between statements, while maintaining grammatical correctness and precision in word choice. The style follows appropriate British English spelling, grammar and formatting conventions. The determination of the content validity of the B-Pro DeTEct learning model is based on the assessment outcomes of the model itself and test instruments, which have undergone prior validation. The evaluation findings indicate that all of the aforementioned meet the validity criteria. However, there remain several areas that require further refinement in accordance with the validators' recommendations, as outlined in Table 3.3

The test results for the instrument validity of the B-Pro DeTEct learning model, obtained by filling in the validation instrument validity assessment sheet, were analysed by two expert validators and one user validator. The data revealed an average instrument validity assessment percentage of 86.3%, with assessment results of 83.92%, 91.07%, and 83.92% from each validator, respectively. The syllabus, lesson plans, LKPD, learning outcome test questions, and creative thinking skills were validated, resulting in a 83.24%, 86.21%, 85.76%, 87.17%, and 71.66% validity score. Four validation tests were conducted, and based on these results, the B-Pro DeTEct learning model was deemed highly applicable.

The effectiveness of the B-Pro DeTEct learning model is demonstrated by the evaluation of the pre- and post-test results. The computations for the pre- and post-tests were appraised using N-gain analysis, which is appropriate for evaluating the results of pre- and post-tests of numerous students with varying levels of knowledge (Nissen, et al., 2018). According to the efficacy findings, the results obtained from table 4.11 demonstrate that the pre-test and post-test scores of 0.46 for the class that underwent learning model development fall under the moderate category. An increase in cognitive learning outcomes experienced by students is an indication of the efficacy of the learning model (Harnitayasari, 2015). Memory cannot be separated from the workings of the brain. This principle aligns with the learning theory of neuroscience, which concerns how the brain functions holistically in cognition, behaviour and action (Suprapto & Duki, 2015). Neuroscience is the area of study regarding the nervous system in the human brain, whereby the nervous system plays a physical role in the process of acquiring knowledge. The human brain is composed of axons, responsible for relaying information to the body. It receives stimulation through two means: electrical and chemical signals. Information is stored and recorded through these signals. (Nurasiah, 2016).

The brain is a complex organ composed of multiple parts, but when it comes to cognition, the right and left hemispheres take centre stage. Even though each hemisphere has its own unique repertoire of functions, both work in harmony together. The right hemisphere is responsible for imagination, emotion, music, creativity, and long-term memory retention. On the other hand, the left hemisphere takes charge of tasks such as language, counting, writing, and more. The left and right brain have differing memory capabilities, with the left brain possessing a shorter memory capacity (Sumardi & Yusuf, 2014). When learning, the incorporation of music can enhance the pleasure of the experience whilst also improving memory capacity. For instance, classical instrumental music may be used whilst students read new material, generating a relaxation response and reducing feelings of depression or anxiety (Dharmawan, 2015).

4. CONCLUSION

The research stage of the development of the B-Pro DeTEct learning model revealed that the model is valid, according to very strong criteria, and is practical, with good to very good criteria. It was also found to be moderately effective. Therefore, it can be concluded that the B-Pro DeTEct learning model positively impacts the creative thinking skills of students in junior high school/MTs.

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6. REFERENCES

Abdurrahman, G., & Sintawati, M. (2013). Strategi brain-based learning dalam pembelajaran matematika untuk mengembangkan kemampuan berpikir kriitis dan kreatif siswa. Surabaya: SNMA UNAIR.

Afni, N., Wahid, A., Hastati, S., Jumrah, A. M., & Mursidin, M. (2021). Pengembangan Model Pembelajaran Abad 21 di SD Negeri 126 Borong Kecamatan Herlang Kabupaten Bulukumba. Madaniya, 2(2), 137-142. doi:10.53696/27214834.66

Aini Mellyatu dan Aini Meliyatul (2023) Enhancing Creative Thinking and Communication Skills Through Engineering Design Process (EDP) Learning Model: A Case Study.*Bioedukasi.*21(1)

Aka, K. A. (2019). Integration Borg & Gall (1983) and Lee & Owen (2004) models as an alternative model of design-based research of interactive multimedia in elementary school. OP Conf. Series: Journal of Physics: Conf. Series, (pp. 1-8). doi:10.1088/1742-6596/1318/1/012022

Arık, M., & Topçu, M. S. (2020). Implementation of Engineering Design Process in the K-12 Science Classrooms: Trends and Issues. Research in Science Education, 52(1), 21-43. doi:10.1007/s11165-019-09912-x

Asyrafah, A. 2019. Menimbang Model Pembelajaran (Kajian teoritis-Kritis atas Model pembelajaran dalam pendidikan Islam). Tarbawy: Indonesian Journal of Islamic education: 6(1): 19-32.

Bampasidis, G., Piperidis, D., Papkonstantinou, V., Stathopoulos, D., Troumpetari, C., & Poutos, P. (2021). Hydrobots, an Underwater Robotics STEM Project: Introduction of Engineering Design Process in Secondary Education. Retrieved from https://files.eric.ed.gov/fulltext/EJ1309105.pdf

Bonomo, V. (2017). Brain-Based Learning Theory. Journal of Education and Human Development, 6(1), 27-43.

Borg, W. R., & Gall, M. D. (1983). Educational Research. An Introduction. New York US: Longman Inc.

Caine, R. N., & Caine, G. (1990). Understanding a Brain-Based Approach to Learning and Teaching. Retrieved from The University of Vermont: https://www.uvm.edu/~mjk/013%20Intro%20to%20Wildlife%20Tracking/Brain-Based_Learning.pdf

Chu, S. K., Reynolds, R. B., Tavares, N. J., Notari, M., & Lee, C. W. (2017). 21st Century Skills Development Through Inquiry-Based Learning. Singapore: Springer Singapore. doi:10.1007/978-981-10-2481-8

Dharmawan, T. 2015. Musik Klasik dan Daya Ingat Jangka Pendek pada Remaja. Jurnal ilmiah Psikologi terapan. 3(2):370-382.

Farmer, e. (2012). Engineer your world: An innovative approach to developing a high school engineering design course. Retrieved from https://peer.asee.org/engineer-your-world-an-innovative-approach-to-developing-a-high-school-engineering-design-course.pdf

Fortuna, R. A., & Yanti, F. (2021). Upaya Meningkatkan Literasi Sains Siswa Sekolah Dasar dalam Pembelajaran Daring Akibat Covid-19. Jurnal Basicedu, 5(4), 2054-2061.

Froschl, M., & Sprung, B. (2005). Raising and Educating Healthy Boys: A Report on the Growing Crisis in Boys' Education. New York: Educational Equity Center Academy for Educational Development.

Harnitayasri, Nurhayati, Irma, S. 2015. Pengaruh Metode Pembelajaran Tipe Talking Chips terhadap Hasil Belajar Siswa Pada Kompetensi Dasar Memahami Model Atom Bahan Semi Kondukyor di SMK Negeri 1 Jetis Mojokerto. Jurnal Pendidikan Teknik Elektro. 4(3):999-1005.

Hill-Cunnngham, P. R., Mott, M. S., & Hunt, A. B. (2018). Facilitating an elementary engineering design process module. School Science and Mathematics, 118(1-2), 53-60.

Jefferson, M., & Anderson, M. (2017). Transforming Schools: Creativity, Critical Reflection, Communication, Collaboration. London UK: Bloomsbury Academic.

Jihad, A., & Haris, A. (2013). Evaluasi Pembelajaran. Yogyakarta: Multi Pressindo.

Junaedi, B., & Lestari, S. (2017). Penerapan Pendekatan Brain Based Learning dengan Metode Hypnoteaching Terhadap Pemahaman Konsep Matematika Siswa. MES: Journal of Mathematics Education and Science, 2(2).

Kennedy, T. J., & Akpan, B. (2020). Science Education in Theory and Practice: An Introductory Guide to Learning Theory. Cham: Springer Nature Switzerland AG.

Kristyowati, R., & Purwanto, A. (2019). Pembelajaran literasi sains melalui pemanfaatan lingkungan. Scholaria: Jurnal Pendidikan Dan Kebudayaan, 9(2), 183-191.

Kunar, J., & Mishra, S. (2019). Effect of Brain Based Learning Strategies on Students' Achievement in Science. International Journal of Advanced Research and Development, 4(4), 55-62.

Kuniati, N., Khaliq, A., & Bulan, A. (2019). Penilaian Sikap Pengetahuan dan Keterampilan Dalam Pembelajaran Bahasa Inggris yang Berorientasi Kurikulum 2013. Seminar Nasional Taman Siswa Bima. 1, pp. 309-316. Bima: LPPM STKIP Taman Siswa Bima.

Massachusetts Department of Education. (2006). Massachusetts Science and Technology Engineering Curriculum Framework. Retrieved from doe.mass.edu: https://files.eric.ed.gov/fulltext/ED508413.pdf

Mcleod, S. (2023, Juni 9). Tahapan Perkembangan & Teori Kognitif Jean Piaget. Retrieved from SimplyPsychology: https://www.simplypsychology.org/piaget.html

Morgan, P. L., Farkas, G., Hillemeier, M. M., & Maczuga, S. (2016). Science Achievement Gaps Begin Very Early, Persist, and Are Largely Explained by Modifiable Factors. Educational Researcher, 45(1), 18-35. doi:10.3102/0013189x16633182

Morjani, I., & Indrapraja, D. K. (2016). Penggunaan Media Musik Sebagai Aspek Pendukung Dalam Belajar Seni Budaya Di SMP. Jurnal Pendidikan dan Kebudayaan Khatulistiwa, 5(1), 1-19. doi:10.26418/jppk.v5i1.13302

Nengsih, N. R., Yusmaita, E., & Gazali, F. (2019). Evaluasi validitas konten dan konstruk bahan ajar asam basa berbasis REACT. EduKimia: Official Journal from Chemistry Education Study Programme, 1(1). doi:10.24036/ekj.v1i1.104017

Nurasiah. 2016. Urgensi Neuroscience dalam Pendidikan. Jurnal Pendidikan Islam. 7: 72:93.

Nissen, J.M., Robert M.T., Amreen, N.T., and Ben, V. D. 2018. Comparison of normalized gain and Cohen's d for analyzing gains on concept inventorie. Journal American Physical Society. 2469-9896/18(1)/0101115

Nurdyansyah, N., & Amalia, F. (2018). Model Pembelajaran Berbasis Masalah Pada Pelajaran IPA Materi Komponen Ekosistem . Sidoarjo: Universitas Muhammadiyah Sidoarjo.

Nurrita, T. (2018). Pengembangan Media Pembelajaran untuk Meningkatkan Hasil Belajar Siswa. Misykat, 3(1), 171-187.

Oktaviana, S. (2022). PERANCANGAN MEDIA PEMBELAJARAN BIOLOGI BERBASIS ANDROID DI SMA NEGERI 1 KAPUR IX. Indonesian Research Journal on Education: Jurnal Ilmu Pendidikan, 3(1), 403-414. Retrieved from https://irje.org/index.php/irje/article/download/210/127

Oktaviani, A., Herpratiwi, & Sukirlan, M. (2015). Evaluasi Program Pembelajaran Bahasa Inggris. Jurnal Teknologi Informasi Komunikasi Pendidikan, 1-11.

Ratnawulan, E., & Rusdiana. (2014). Evaluasi Pembelajaran Dengan Pedekatan Kurikulum 2013. Bandung: Pustaka Setia Bandung.

Rusman, R. (2014). Model-Model Pembelajaran. Jakarta: PT. Rajagrafindo.

Sanjaya, W. (2011). Strategi Pembelajaran Berorientasi Standar Proses. Jakarta: Prenada Media.

Sesmiarni, Z. (2016). Model Brain Based Teaching Sebagai Transformasi Paradigma Pembelajaran di Perguruan Tinggi. Tadris: Jurnal Keguruan dan Ilmu Tarbiyah, 1(2), 93-104.

Shabatat, K., & Al-Tarawneh, M. (2016). The Impact of a Teaching-Learning Program Based on a Brain-Based Learning on the Achievement of the Female Students of 9th Grade in Chemistry. Higher Education Studies, 6(2), 162-173.

Siang, J. L. (2020). Pengaruh Model Pembelajaran dan Kemampuan Berpikir Kreatif. Jurnal Teknologi Pendidikan, 22(1), 40-52. doi:https://doi.org/10.21009/jtp.v22i1.15329

Suherman. 2018. Kurikulum Pembelajaran Penjas. Sumedang: UPI Sumedang Press.

Sumantri, M. S. (2015). Strategi Pembelajaran. Depok: PT. Rajagrafindo.

Sumardi, Yusuf, M.H. 2014. Perbandingan Kinerja Otak Kiri dan Otak Kanan dalam Perkuliahan Mahasiswa Jurusan Pendidikan Fisika Fakultas Tarbitah dan Keguruan UIN alauddin Makassar. Jurnal Pendidikan Fisika.3(1):84-86.

Suprapto, A., Duki. 2015. Pengembangan metodologi pembelajaran PAI melalui teori pemrosesan informasi dan teori neurosciense. J-PAI. 2(1):23-51

Sutianah, C. (2021). Belajar dan Pembelajaran. Pasuruan: CV Penerbit Qiara Media.

Syarwan, R. (2014). Pengaruh Pendekatan Brain Based Learning (BBL) terhadap Kemampuan Penalaran Matematis Siswa Kelas VII SMP Islam Raudhatul Jannah Payakumbuh. Padang: Doctoral dissertation, Universitas Negeri Padang.

Tahapan Perkembangan & Teori Kognitif Jean Piaget. (2023, Juli 7). Retrieved from SimplyPsychology: https://www.simplypsychology.org/piaget.html

Thomas, B. M., & Swamy, S. S. (2014). Brain based teaching approach: A new paradigm of teaching. International Journal of Education and Psychological Research, 3(2), 62-65.

Trianto. (2014). Mendesain Model Pembelajaran Inovatif, Progresif, dan Kontekstual. Jakarta: Kencana.

Vygotsky, L. S. (1987). The collected works of LS Vygotsky: Volume 1. Thinking and speaking. New York US: Plenum Press.

Wahyuni, N. (2014, November 1). Uji Validitas dan Reliabilitas. Retrieved from BINUS University: Quality Management Center: https://qmc.binus.ac.id/2014/11/01/u-j-i-v-a-l-i-d-i-t-a-s-d-a-n-u-j-i-r-e-l-i-a-b-i-l-i-t-a-s/

Wisudawati, A. W., & Sulistyowati, E. (2014). Metodologi Pembelajaran IPA. Jakarta: PT Bumi Aksara.

Woolfolk, A. E. (2014). Educational psychology. Noida, India: Dorling Kindersley India Pvt. Ltd.

Wulandari, B., & Surjono, H. D. (2013). Pengaruh problem-based learning terhadap hasil belajar ditinjau dari motivasi belajar PLC di SMK. Jurnal Pendidikan Vokasi, 3(2), 178-191. doi:10.21831/jpv.v3i2.1600

Yaşar, M. D. (2017). Brain Based Learning in Science Education in Turkey: Descriptive content and Meta analysis of dissertations. Journal of Education and Practice, 8(9), 161-168.