Implications of Constructivism Learning Theory in Increasing Student Activity and Creativity on Project-based Learning Model

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ABSTRACT
An interactive learning process that can activate students to share, build, shape is part of the essence of constructivism theory. Students who have this trait and their peers play a very important role in the project-based learning model (PjBL). In its application, students are expected to be able to actively practice independence, collaborate and experiment together in groups to plan, create, and process. The results of research at SMKN 2 *Gowa* which were applied to the Microcontroller subject showed an increase in student activity and creativity. This study used a quasi-experimental method with a non-equivalent pretest-posttest design.

Keywords: *PjBL model, Activity, Creativity, Constructivism, SMK.*

1. INTRODUCTION

Entering the 21st century, the industrial revolution 4.0, technological advances are increasingly entering various aspects of life, including in the field of education. This technological advancement has changed human life style, both in working, socializing, playing and studying. Changes occur from the curve to the approach, learning media changes according to the times.

According Widiawati et al stated that 21st century learning is learning that requires high-order thinking skills. Higher order thinking skills are skills that train students to solve problems that will be faced in the future so that these skills are skills that must be possessed [1].

However, it has undergone changes, but in reality what is generally being improved is only a way to improve student learning outcomes or achievements, which sometimes will hinder a student in developing activities and even creativity for competence in the field he likes.

The problem of students' delays in increasing competence is not only due to one factor, but there are several factors that must be considered. The very dominant factor in hindering the development of student activity and creativity is the teaching style which seems boring which is commonly called the priority lecture method to educators which is carried out by most educators.

1.1. Constructivistic PjBL Model Concept in Microcontroller

Constructivism is a widely supported learning theory that rests on the idea that students construct their own knowledge in the context of their own experiences. There is an opportunity to convey ideas, listen to the ideas of fellow students and reflect on one's own ideas, which is a form of social transaction learning that can occur through PjBL by conducting joint and group investigations. Supported by the research results of Fadila Putri & Hanesman which showed a positive effect on learning outcomes through PjBL learning applications [2].

Microcontrollers are one of the basic studies at C2 and C3 levels, which are essential subjects in the Electrical Engineering Program at Vocational High Schools. In learning Microcontrollers students learn applied science whose applications can be found in everyday life on various home appliances, for example washing machines, home security systems. In addition, microcontrollers can be used for industrial automation, data acquisition, telecommunications, and others.

The implication of this microcontroller learning, challenging students to be active in learning that involves intellectual abilities in new ideas , is modified so that these students can combine students who have high creativity and activity. Learning activity is a factor that greatly determines success of the student-teacher learning process, because in principle learning is doing [3].

1.2. Activity and Creativity Concept

Learning activities use all individual potential so that certain behavioral changes will occur. Changes occur because of learning and learning activities which are characterized by student activity[5]. Some experts argue that students in learning must have the opportunity to carry out activities, because student activity is an absolute requirement for the ongoing interaction of learning and learning. Learning activities occur in a planning context to achieve a certain change [6]. Creativity is an important aspect in building a good educational culture [7].

Good creativity is displayed with learning outcomes that do not only focus on improving cognitive abilities but also on problem solving processes. Creativity is the skill to make combinations with information that is in the right hemisphere of the brain that needs to be specifically nonverbal and holistic, intuitive, imaginative [8].

Thus learning activities in learning activities that involve intellectual abilities in new ideas are modified so that these students can combine as students who have high activity and creativity.

1.3. Constructivism Approach in the PjBL model

The constructivism approach is a learning process that directs students to construct their own ideas, then find their own knowledge learned to form a learning community by reflecting on all the material.

The goals of constructivism are (a) developing students' ability to ask questions and search for their own questions; (b) helping students to develop a complete understanding and understanding of the concept; (c) developing students' ability to become independent thinkers. The characteristics of this approach are group work based on inquiry and discovery through structured assignments, and flexible authentic assessments, demonstrations and baptizing of students [9].

Along with the characteristics of this constructivist approach , it is hoped that the PjBL model which is an innovative learning model , which suppresses contextual learning through complex activities , can increase student activity and creativity. PjBL has several principles in its application; (a) centralized; (b) guiding questions; (c) constructive investigation; (d) autonomy; (e) realistic [10]. This learning model is an innovative learning that involves project work where students work independently in constructing learning and culminating it in real products [11].

The steps (syntax) of PjBL explained by Muskania & Wilujeng, namely; (1) asking questions originating from surrounding phenomena, (2) designing stages in project completion,(3) arranging project implementation schedules, (4) Gathering , analyzing and interpreting data using information, computer technology and five-year thinking , (5) Compilation of reports and presentation of projects, (6) Evaluation of project processes and results [12].

2. RESEARCH METHODS

This research used a quasi-experimental method with a non-equivalent pretest-posttest design. The experimental group in class A and the control group in class B were selected without random transfer. Group E experiment A was given treatment with PjBL syntax and k control group B used lecture. Nonequivalent control group design is a semi-experimental design that uses an experimental group and a control group. Both groups were given pre-test and post-test and only the experimental group received treatment. Creswell describes the non-equivalent control group design pattern as follows [13].

Table 1. Pretest- Posttest Nonequivalent Control Group Design

Group	Pretest	Experimental	Posttest
A	O_1	X	O_2
B	O_3	-	O_4

Description Table 1
O_1 : Pretest score experimental group
O_2 : Posttest score experimental group
O_3 : Pretest score control group
O_4 : Posttest score control group
A : Experimental Group
B : Control Group
X : PjBL Learning

2.1. Population and Sample

The population in this study were students at SMKN in Gowa, South Sulawesi, which consisted of 4 classes totaling 145 students. From the existing population, two classes were taken randomly as research samples at SMKN 2 Gowa. Furthermore, the samples from the two selected classes were randomly assigned to one class as group A (experimental) and another class as group B (control), each of which totaled 37 students.

2.2. Data Collection Techniques and Instruments

2.2.1. Data Collection Techniques

Data was collected via test offerings to both experimental and control groups. The test is used to measure the level of understanding of the Microcontroller concept according to the material on the standard graduation content in the Curriculum. Posttest was given to both groups after being given treatment. Data from pretest and posttest results were analyzed to then draw conclusions. Data from observations of student activity and creativity were obtained through observation data the implementation of PjBL observed in experimental group.

2.2.2. Research Instruments

The instruments used to collect research data are; (a) Test conducted to measure the level of understanding of the concept of microcontroller. The test used is scratch questions totaling 8 items, (b) Observation sheets to determine student creativity and activity in PjBL implementation. Observations were made 5 times during the learning process in both groups. These observations are used to see an increase in student learning activity and creativity at each face-to-face meeting. The criteria used differ into four (4) categories, namely poor, enough, good and very good in Table 2.

Table 2. Criteria for Activity and Creativity

Indicator	Category
3.5 – 4.0	Very Good
2.5 – 3.4	Good
1.5 – 2.4	Enough
1.0 – 1.4	Poor

2.3. Instrument Validation

Content validity of a test that must answer questions covers the entire measurable situation. The stages of instrument validation are carried out as follows: (a) making a specification table, (b) compiling items based on the specifications table, (c) consulting the instrument with the expert (validator) and (d) revising the instrument based on the input validator [14].

2.4. Data analysis technique

The technique used to analyze pretest data and posttest data is the t test according to Hinkle (1979), with formula (1) as follows;

$$t = \frac{x_1 - x_2}{\sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1+n_2-2}\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}} \quad (1)$$

Before testing the hypothesis, a prerequisite analysis test was carried out through the normality test according to formula Sugyono [15], (2) and homogeneity test according to Glass & Hopkins, formula (2) as follows[16];

$$\chi^2 = \sum_{i-1}^{k} \frac{(f_0 - f_h)^2}{f_h} \quad (2) \qquad F = \frac{S_1^2}{S_2^2} \quad (3)$$

Information :

X^2 = Chi Squared,
F = Fstat homogeneity test,
f_0 = Observed frequency
S_1^2 = Largest variance
f_h = Expected frequency
S_2^2 = Smallest variance

To compare mastery of classical learning between two groups, a test of differences in learning completeness was carried out using the Chi-square test (x^2)[17], in formula (4) as follows;

$$\chi^2 = \frac{n \times \left(\left|a \times d - b \times c\right| - \frac{1}{2}n\right)^2}{(a+b)\times(a+c)\times(b+d)\times(c+d)} \quad (4)$$

Information:

a = complete experimental group.
b = incomplete experimental group.
c = complete control group.
d = incomplete control group

3.RESEARCH RESULTS AND DISCUSSION

Data description is description of the data obtained to support discussion of research results. The description of data includes the mean, standard deviation, variance, minimum value and maximum value. Furthermore, the observational data which are quantitative in nature, are in the form of figures from the calculation process by adding them up, compared to the expected amount and obtaining the proportion.

The results of the analysis of descriptive statistical data, as in Table 1, the highest value is 100 and the lowest value is 10.

Table 3. Summary Description Test Data

Description	Experiment Group (A) (n=37)		Control Group (B) (n=37)	
	Pretest	**Posttest**	**Pretest**	**Posttest**
Mean	26.4	82.2	25.7	68.6
Standard deviation	8.3	9.9	8.2	10.9
Variance	68.9	97.9	66.9	120.3
Maximum value	40	100	40	90
Minimum value	10	65	10	50

Table 3 shows that the average pretest understanding of the concept in the experimental group is 26.4 and the control group is 25.7 while the posttest group average experiment 82.2 and control group 68,6.

The learning completeness data for each group is presented in Table 4. A summary of the results of the Chi-Square test is presented in Table 5.

Table 5. Summary of Learning Mastery Chi-Square Test

Intergroup Test	X^2 count	Conclusion
A-B	7.1458	Significantly different

Learning completeness in the pretest is displayed to reveal the similarities in the students' initial conditions as research subjects, namely that in the pretest the two research groups were not complete in learning.

Chi-Square analysis shows that the value χ^2_{hitung} (AB) = 7.1458 > χ^2_{tabel} = 3.8415 then H_0 is rejected. At a significance level of 0.05 (confidence level 95%) there is a significant difference between the learning mastery of the experimental group (A) and the learning mastery of the control group (B). Therefore it can be concluded that the learning mastery of students in microcontroller subjects taught through PjBL is higher than the learning mastery of students who learn through direct learning.

The results of student learning activity and creativity data were obtained through observation sheets with 12 statement items, during treatment learning in the experimental group with the PjBL application model. Descriptive analysis of results for activities can be seen in Table 6 and Creativity in Table 7 below.

Table 7. Data on Student Creativity Analysis Results

Measures Tendency and Dispersion	Initial Skills (Creativity)	Final Skills (Creativity)
Amount (N) Valid	37	37
Average Score (Mean)	2.85	3.51
Standard Deviation Score (Mean)	0.268	0.270
Median Score	2.83	3.50
Score Mode	2.58	3.33
Range Score	1.00	0.92
Minimum Score	2.42	3.08
Maximum Score	3.42	4.00

An overview of the increase in student learning creativity in the experimental group (A) can be seen by comparing the scores of initial and final creativity in Table 7, which shows that student learning creativity has increased with the application of the PjBL model to microcontroller subjects.

Thus honing students' abilities to think more critically, complete and produce quality projects that can benefit students and their environment. In addition to increasing student activity, the PjBL model is also able to increase student creativity [18]. After implementing the PjBL model there was an increase in student activity [19].

The effectiveness of a measure that is expressed how far the target (quantity, quality and time) has been achieved, or the greater the value of the target achieved, the higher the effectiveness [20]. If students can learn to complete projects, then indirectly there will be hidden character values contained in these learning activities [21].

Referring to the research results, the PjBL learning model shows an increase in student learning creativity according to learning activities and real tasks in constructing knowledge. This proves that there is a role for constructivism learning objectives to (a) provide opportunities for students to interact directly with concrete objects, (b) pay attention to students' initial conceptions for the owner of the correct concept, and (c)

Table 4. Study Completeness Data

Group	Pretest		Posttest		amount student	Complete	
	complete	**unfinished**	**complete**	**unfinished**		**Pretest**	**Posttest**
A	0	37	37	0	37	0%	100%
B	0	37	33	4	37	0%	89.19%

Table 6. Data on Student Activity Analysis Results

Measures Tendency and Dispersion	Data Activity				
	Learning-1	Learning -2	Learning -3	Learning -4	Learning -5
Amount (N) Valid	37	37	37	37	37
Average Score (Mean)	2.19	2.53	3.02	3.20	3.29
Standard Deviation Score (Mean)	0.465	0.493	0.366	0.336	0.299
Median Score	2.33	2.50	3.12	3.17	3.21
Score Mode	2.67	2.50	3.25	2.92	3.17
Range Score	1.67	1.92	1.25	1.33	1.17
Minimum Score	1.33	1.58	2.33	2.50	2.75
Maximum Score	3.00	3.50	3.58	3.83	3.92

as a process of changing students' existing conceptions. exist and may be wrong [22].

According to Bada & Olisegun there are two characteristics that are central to the construction description, namely: (a) Problems, construction learning asks students to use knowledge to solve problems. Problems provide a context for students to apply knowledge and take ownership of their learning, and good problems stimulate the exploration and reflexes necessary to construct knowledge; (b) Collaboration, the construction perspective supports student learning through interaction with others meaning students work together as peers, apply their combined knowledge to problem solutions[23].

PjBL is a trigger for independence, collaboration, and creativity. The ability to collaborate in the world of education is increasingly needed, because collaboration will build creativity which is the essence of the Freedom to Learn policy [24].

4. CONCLUSION

Based on research results, PjBL shows more effectiveness than conventional learning. This is because the steps in the PjBL model prioritize creativity and high student activity in the learning process.

Furthermore, the PjBL model is a constructive model, with potential and high-level cognitive ability, which can motivate students to increase activity and creativity.

Assumption from constructivism that humans are active students who can develop knowledge for themselves and must collaborate and interact in study groups [25].

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REFERENCES

[1] Widiawati Leni, et al (2018). Higher Order Thinking Skills as Effect of Problem Based Learning in the 21st Century Learning. International Journal of Multicultural and Multireligious Understanding Vol.5 No.3 (https://ijmmu.com/index.php/ijmmu/article/view/223)

[2] Fadila Putri & Hanesman. (2020). Pengaruh Penerapan Model Pembelajaran Project-Based Learning Terhadap Hasil Belajar. Jurnal VoteTeknikaVol.8 No.1. https://ejournal.unp.ac.id/index.php/voteknika/article/view/107688

[3] Khoiri,N, Marinia & Kurniawan, W. (2017). Keefektifan Model PjBL terhadap Kemampuan Kreativitas dan Hasil Belajar Jurnal Penelitian Pembelajaran Fisika. https://doi.org/10.26877/jp2f.v7i2.1309

[5] Johar & Hanum (2016). Strategi Belajar Mengaajar.Yogyakarta. Grup Penerbit CV Budi Utama.

[6] Rusman. (2017). Model-Model Pembelajaran. Jakarta: Rajawali Pers, 2012.

[7] Ramdani et al.(2019). Pengujian Level Kreativitas pada Siswa Berdasarkan Skala Kekuatan dan Kebijakan Karakter dan Tes Kreativitas Herbal. Jurnal Ilmu Perilaku. Vol.2.No.2, http://jip.fk.unand.ac.id/-index.php/jip/article/view/84

[8] Vera et al. (2019). Peningkatan Kreativitas dan Hasil Belajar Siswa Melalui Model Pembelajaran PjBL. Jurnal Ilmiah Pendidikan Matematika. (Online). Vol.6, No.1, https://scholar.google.co.id

[9] Thobroni M (2015) Belajar dan Pembelajaran: Teori dan Praktek. Yogjakarta: Arr-Ruzz Media
[10] Made Wena. (2013). Stategi Pembelajaran Inovatif Kontemporer. Jakarta: Bumi Aksara
[11] Sitaresmi, K. S., & Saputro, S. (2017). Penerapan PjBL untuk meningkatkan aktivitas dan prestasi belajar siswa. Jurnal Pendidikan Kimia, 6(1)
[12] Muskania & Wilujeng. (2017). Pengembangan Perangkat Pembelajaran PjBL untuk Membekali Fundational Knowledge dan Meningkatkan Scientific Literacy. (Online), Jurnal Cakrawala Pendidikan, Februari 2017 Th. XXXVI No.1
[13] Creswell, J (2002). Educational research: Planning,conducting, and evaluating quantitative and qualitative research. Upper Saddle River, NJ: Merrill Prentice Hall
[14] Djemari Mardapi. (2004). Penyusunan tes hasil belajar. Yogykarta: Program Pascasarjana Universitas Negeri Yogyakarta.
[15] Sugiyono. (2017). Metode Penelitian Administrasi Dilengkapi dengan Metode R&D. Bandung: Alfabeta.
[16] Glass. G. V. & Hopkins. K. D. (1984). Statistical methods in education and psychology. Englewood Cliffs, New York: Prentice Hall.
[17] Sudjana (2005) Meika & Sujana. 2017. Kemampuan Berpikir Kreatif Dan Pemecahan Masalah Matematis Siswa SMA. Jurnal Penelitian Dan Pembelajaran Matematika. (Online), Vol. 10, No. 2, (http://dx.doi.org/10.30870/jppm.v10i2.2025
[18] Rahmazatullaili et al. (2017). Kemampuan berpikir kreatif dan pemecahan masalah siswa melalui penerapan model PjBL. Beta Jurnal Tadris Matematika, 10(2), https://doi.org/10.20414/-betajtm.v10i2.104
[19] Utami et al. (2018). Penerapan Model Pembelajaran Project Based Learning untuk Meningkatkan Kreativitas dan Hasil Belajar Ipa. Jurnal Mitra Pendidikan. (Online), Vol.2, No.6, (https://scholar.google.co.id
[20] D.Kenneth, Moh Syarif. (2015). Pembelajaran Efektif. Jakarta: Grasindo.
[21] Indasari, M. (2018).Mendidik Karakter Anak melalui Model PjBL (Sebuah Desain Pembelajaran Matematika yang Berkarakter). Scholaria: Jurnal Pendidikan dan Kebudayaan 8 (1)
[22] Krahenbuhl, KS. (2016). Student-centered Education and Constructivism: Challenges, Concerns and Clarity for Teachers. The Clearing House: A Journal of Educational Strategies, Issues and Ideas.
[23] Bada & Olusegun,S. (2015). Constructivism Learning Theory: A Paradigm for Teaching and Learning. IOSR Journal of Research & Method in Education (IOSR-JRME) Volume 5, Issue 6 Ver. I
[24] Nadiem M. (2021). Mendikbud Dorong PembelajaranPjBL. https://www.kompas.com/edu/read/2021/04/22/161500771/mendikbud-nadiem-dorong-pembelajaran-project-based-learning-seperti-apa
[25] Dale H. Schunk. (2012). Learning Theories An Education Perspective. (diterjemahkan Eva Hamdiah, Rahmat Fajar,. dengan Judul Teori-Teori Pembelajaran Perspektif Pendidikan). Yogyakarta, Pustaka Pelajar.