



# Psychomotor Skills-Self Renewal Capacity of Students with the PACE Model based on Project Based Learning

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## Abstrak

Kemampuan psikomotor pada self renewal capacity mahasiswa masih rendah pada kompetensi mempraktekkan database MySQL sehingga diperkirakan mahasiswa mempunyai kendala dalam menyelesaikan proyek tugas akhir pada mata kuliah pemrograman berorientasi objek. Penelitian ini bertujuan meningkatkan kemampuan psikomotor mahasiswa menyelesaikan proyek tugas akhir melalui implementasi penggunaan model PACE berbasis project based learning. PACE merupakan model pembelajaran berlandaskan konstruktivisme dengan fase: Proyek (Project), Aktivitas (Activity), Pembelajaran Kooperatif (cooperative Learning) dan Latihan (Exercise), model ini cocok di kombinasikan dengan project based learning untuk meningkatkan Self renewal capacity mahasiswa dalam melakukan praktek pemrograman. Jenis penelitian ini deskriptif dengan pendekatan kualitatif. Subjek penelitian adalah mahasiswa semester 3 program studi Pendidikan Teknik Informatika sebanyak 23 Orang. Hasil penelitian menunjukkan nilai rata-rata keterampilan psikomotor mahasiswa pada indikator kemampuan merancang dan mendesain adalah 5 dengan kriteria sangat baik, indikator kemampuan menganalisis source code adalah 4 dengan kriteria Baik, indikator kemampuan membuat dan menganalisis database adalah 4 dengan kriteria baik, indikator kemampuan membuat dan menganalisis report pada adalah 4 dengan kriteria Baik, dan indikator kemampuan mempresentasikan hasil adalah 4 dengan kriteria baik. Kemudian Self renewal capacity menunjukkan persentase 71.7% dengan kriteria baik. Disimpulkan, penerapan model PACE berbasis Project Based Learning pada mata kuliah pemrograman berorientasi objek dapat menjadi Alternatif meningkatkan self renewal capacity pada kemampuan psikomotor mahasiswa.

**Kata Kunci:** Model Pembelajaran, PACE, Project Based Learning, Self Renewal Capacity, Psychomotor Skill.

## Abstract

Psychomotor abilities in students' self renewal capacity are still low in competence in practicing MySQL databases so it is estimated that students have problems in completing the final assignment project in object oriented programming courses. This study aims to improve students' psychomotor abilities in completing their final project through the implementation of the use of the PACE model based on project based learning. PACE is a learning model based on constructiveness with phases: Project, Activity, Cooperative Learning and Exercise, this model is suitable to be combined with project based learning to increase students' self renewal capacity in doing programming practice. This type of research is descriptive with a qualitative approach. There were 23 students of the Informatics Engineering Education study program as the subject of this research. The results showed that the average score of students' psychomotor skills is 81.2% with very good criteria. Then Self renewal capacity shows a percentage of 71.7% with good criteria. In conclusion, the application of the PACE model based on Project Based Learning in object-oriented programming courses can be an alternative to increase self-renewal capacity in students' psychomotor abilities.

**Keywords:** Learning Model, PACE, Project Based Learning, Self Renewal Capacity, Psychomotor Skill.

### History:

Received : July 12, 2023

Revised : July 14, 2023

Accepted : October 06, 2023

Published : October 25, 2023

**Publisher:** Undiksha Press

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## 1. INTRODUCTION

The lecture period with online learning when Covid has turned to offline lectures is marked by the disappearance or subside of the Covid 19 outbreak, lectures are running normally, especially in object-oriented programming courses, they can be carried out again offline on computer laboratories (Akbarjono et al., 2022; Lusiyani & Dara Anindya, 2021). Object-oriented programming lectures require students to solve program problems by providing objects (consisting of various attributes and methods) that are interrelated and arranged into one group or what is called a class (Gálvez et al., 2016; Wu & Nian, 2021).

Later these objects will interact with each other to solve complex program problems in producing programs that are ready for use by the public. Good lecture goals and good student grades marked by students being able to make program applications according to the theme given and can be used in the community later. Students' ability to renew knowledge and increase self-potential so that students' psychomotor abilities in programming increase are influenced by self-renewal capacity (Kreth et al., 2019; Saarivirta, 2007).

Previous study describe the concept of renewal capacity is useful for increasing self-potential which must be developed through a learning process in the field of education to maintain personal-environmental harmony dynamically (Suryana, 2015). Self-Renewal Capacity is defined as the overall capacity of individuals or organizations to master change in the form of strategy, operations and knowledge, and to manage information, knowledge and innovation (Saarivirta, 2007). Indicators of Self-Renewal Capacity. The indicators are: i) Exploitation (utilizing existing information for a specific purpose and exploiting the potential that exists within oneself); ii) Exploration (having creative ideas; having an interest in generalizations, proofs, and representations; and having high curiosity about something that is relatively new); iii) Absorption (capable of adapting); iv) Integration (respecting others, prioritizing common interests, and controlling oneself against conflicts); and v) Leadership (working hard in solving problems, having strong motivation from within oneself, having communication skills, making decisions in solving problems, being responsible, and being thorough).

Self-Renewal Capacity is the capacity to always perfect/improve work through learning and self-reflection. In this study, Self-Renewal Capacity is defined as a person's capacity to perfect/improve his performance in learning through exploitation, exploration, absorption, integration, and leadership. In its realization, good self renewal capacity also affects students' psychomotor abilities. According to previous study to improve psychomotor abilities and the power to change one's movements/potentials requires a lot of time, continuous practice and patience as well as good detail (Karal.H & AyyildizU, 2010). Psychomotor abilities are also closely related to learning experience these skills show an increase in the way students solve problems related to certain tasks (Ami & Yuliana, 2021; Noviyanti.H. et al., 2022).

Psychomotor abilities into four categories, namely: i) Mobilizing, ii) Manipulating, iii) Communicating and iv) Creating. So the assessment of psychomotor learning outcomes includes preparation, process, and product. Assessment can be carried out during learning activities, namely when students are practicing or after the process takes place by testing students, one of which is through a practicum results report (Afriana et al., 2016; Bailey et al., 2009; Simbolon & HarunAI, 2016). Realizing an increase in self-renewal capacity and good psychomotor abilities in lectures must also use relevant learning models. In general, a model is a representation of phenomena, objects or ideas. Related to learning according to previous study in the learning model is a plan or pattern that can be used to shape the curriculum (long-term learning plans), design learning materials, and guide learning in class or others (Mirdad, 2020). The learning model can be used as a pattern of choice, meaning that teachers may choose an appropriate and efficient learning model to achieve their educational goals. In this study the learning model that is relevant and suitable for object-oriented programming courses is the PACE learning model, namely Project, Activity, Cooperative Learning and Exercise and also combined with project based learning learning models (Camilleri & Camilleri, 2017; Espino-Díaz et al., 2020; Zainuddin & Perera, 2018).

Students who are taught with the PACE model are more active in the learning process which also applies the discussion method (Suryana.A. 2014). The PACE model is based on the principles of: i) building self-knowledge with guidance, ii) important practice and feedback, and iii) prioritizing active learning in solving a problem. While the Project

Based Learning Model is a learning model that requires students to better understand the material and be able to think critically and be able to analyze problem solving independently, in practice and socialization so it is important for students to improve their learning outcomes (Chen.P. & DongJ, 2015; Dimmitt, 2017; Sankaranarayanan.S. et al., 2020). The PACE model with Project Based Learning is very suitable and is expected to be a solution so that students can enjoy and support the process of interest and creativity in the learning process. The PACE model requires computer technology (Laviatan, 2008; Rozal et al., 2021).

In this study, the PACE model will be adapted to the characteristics of the learning process in the laboratory in object-oriented programming courses that are identical to the final project completion project with predetermined themes, in this case the steps and strategies between the PACE learning model and project-based learning in one learning step (Camilleri & Camilleri, 2017; Kanokorn et al., 2013; Zainuddin & Perera, 2018). In this section, more strategies are applied to the project-based learning model to be developed in implementing the PACE learning model. The learning process in this study made observations on self-renewal capacity with psychomotor abilities which are other indicators of learning success (Saarivirta, 2007; Suryana, 2014). The focus of this research is the utilization of PACE learning model based on project-based learning with the aim to analyze how high the level of students' psychomotor ability through the use of PACE project-based learning model in object-oriented programming courses, and seeing how high the level of students' self-renewal capacity through the use of PACE learning model based on project-based learning in object-oriented programming courses.

## 2. METHODS

This type of research is a descriptive research with a qualitative approach. The qualitative descriptive method is a research method based on the philosophy of post-positivism used to research on natural object conditions (as opposed to experiments) where the researcher is the key instrument (Sugiyono, 2016). The subjects in this study were 23 students of the Informatics Engineering Education Study Program, Faculty of Teacher Training and Education at a private university in West Sumatra province who took Object Oriented Programming courses. The instruments used in this study were the rubric for assessing psychomotor abilities and self-renewal capacity for the final project of an object-oriented programming course with the competency of students being able to make desktop applications using the Visual Basic programming language with 23 different themes. Data collection techniques are carried out in triangulation (combined), data analysis is inductive/qualitative, and the results of qualitative research emphasize meaning rather than generalization. Qualitative descriptive research aims to describe, describe, explain, explain and answer in more detail the problems to be studied by studying as much as possible an individual, a group or an event. Indicators for assessing psychomotor abilities and self renewal capacity can be seen in Table 1.

**Table 1.** Psychomotor Competency Assessment Indicators

No	Indicator/ Assessment Aspect
1	Ability to design and design the final assignment form (A)
2	Ability to analyze source code according to application needs (B)
3	Ability to create and analyze MySQL databases according to the needs of the final project application (C)
4	Ability to make and analyze reports on the final project application (D)
5	Ability to present the results of the final project (E)

The psychomotor skills indicator uses a rating scale instrument, which uses a range that starts with a very poor value to very good (Trianto, 2008). The scoring guidelines for each indicator use a scale of 5 with a score of 20-25 including very good criteria, a range of 15-19 including good criteria, a score range of 10-14 including sufficient criteria, a range of 5-9 including poor criteria and a range of scores less than 5 is very poor criteria as show in Table 2.

**Table 2. Psychomotor Competency Assessment Criteria**

No	Score Range	Percentage Range	Criteria
1	20-25	81-100	Very Good
2	15-19	61-80	Good
3	10-14	41-60	Sufficient
4	5-9	19-40	Less

This study also refers to the value of students' self renewal capacity with assessment indicators which have 5 aspects namely; i) Exploitation with 2 sub-indicators, ii) Exploration with 5 sub-indicators, iii) Absorption with 1 sub-indicator, iv) Integration with 3 sub-indicators and v) Leadership with 6 sub-indicators. Self renewal capacity assessment indicator is show in Table 3.

**Table 3. Self Renewal Capacity Assessment Indicator**

No	Indicator/ Assessment Aspect	Sub Indicator
1	Eksplotation (A)	Utilize existing information for specific purposes (A1) Utilizing the potential that exists within oneself (A2)
2	Eksplorasi (B)	Have creative ideas (B1) Have an interest in generalization (B2) Have an interest in proof (B3) Have an interest in representation (B4) Have a high curiosity about something that is relatively new (B5)
3	Absorption (C)	Adaptation (C1)
4	Integration (D)	Respect for others (D1) Prioritize common interest (D2) Control yourself against conflict (D3)
5	Leadership (E)	Work hard in solving problems (E1) Have strong motivation from within yourself (E2)

The self renewal capacity indicator uses a rating scale instrument, which uses a range starting with a very poor value to very good. Adding up the scores for each self renewal capacity indicator so that the total score is obtained. The percentage level as a benchmark is  $80\% < x \leq 100\%$  with a very good category, the percentage level range is  $60\% < x \leq 80\%$  with good category, percentage level range  $40\% < x \leq 60\%$  with sufficient category, percentage range  $20\% < x \leq 40\%$  with less category, and percentage range  $0\% < x \leq 20\%$  with very poor category. Assessment of the Patoka Reference (PAP) self renewal capacity is show in Table 4.

**Table 4. Assessment of the Patoka Reference (PAP) Self Renewal Capacity**

No	Percentage Rate	Category
1	$80\% < x \leq 100\%$	Very Good Category
2	$60\% < x \leq 80\%$	Good Category

No	Percentage Rate	Category
3	$40\% < x \leq 60\%$	Sufficient Category
4	$20\% < x \leq 40\%$	Less Category
5	$0\% < x \leq 20\%$	Very Poor Category

### 3. RESULTS AND DISCUSSION

#### Result

##### Psychomotor Ability

The value of students' psychomotor abilities is based on 5 aspects, namely; i) Ability to design and design final project forms (A), ii) Ability to analyze source code according to application requirements (B), iii) Ability to create and analyze MySQL databases according to requirements in final project applications (C), iv) Ability to create and analyzing reports on the final project application (D), and v) Ability to present the results of the final assignment (E). recap of the results of the detailed psychomotor ability assessment can be seen in [Table 5](#).

**Table 5.** Recapitulation of Psychomotor Competency Assessment Results

No	Indicator	Percentage	Criteria
1	A	90.4	Very Good
2	B	84	Very Good
3	C	79	Good
4	D	77	Good
5	E	75	Good

Based on [Table 5](#), it can be concluded that related to the recapitulation of the results of research on student psychomotor abilities in Object-Oriented Programming courses is classified as very good with an average percentage of 81.2%. The analysis that can be presented related to the results of the research above, namely; For the E indicator, students are actually already good at presenting their final project, but not optimal in emphasizing the advantages that exist in their respective applications, so that sometimes students forget to explain some of the functions in their final project application which is also the most important part. Then in its implementation related to indicator D in the implementation, students already have a print function in the application by reporting on each transaction made in the application and also adding the achievement of making receipts for filtering transactions made specifically for certain objects. However, students are not optimal in making transaction reporting records per week, month, and year. In the next observation in indicator C students have succeeded in creating a MySQL database according to their application needs, whereas in certain cases students with the database do not create tables that should also be added to their application database, such as the login function before entering the application, with the database admin being able to create a new account for the user. without having to make edits to the source in the programming language. Another case with observation on indicator B, It can be seen that the students on this indicator are maximized in the process, it can be seen that students have been able to solve the problems they face marked by making decisions in making forms according to application needs and making the correct code for the functions that exist in each application object



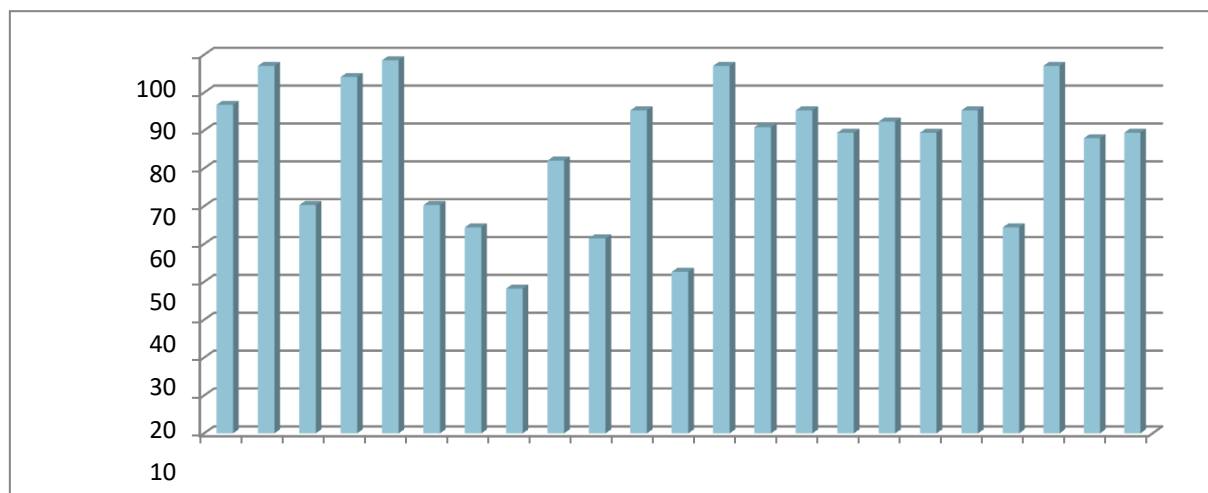
### Self Renewal Capacity

The self renewal capacity value of students is based on 5 aspects namely; i) Exploitation (A), ii) Exploration (B), iii) Absorption (C), iv) Integration (D), and v) Leadership (E). recapitulation of the assessment results can be seen in [Table 6](#).

**Table 6.** recapitulation of Self Renewal Capacity Assessment Results

No	Indicator	Percentage	Criteria
1	A	60.3	Good
2	B	81.1	Very Good
3	C	70.7	Good
4	D	72.8	Good
5	E	73.4	Good

Based on [Table 6](#), it can be concluded that the recapitulation of the results of research on students' self renewal capacity in Object-Oriented Programming courses is classified as good with an average percentage of 71.7%. The analysis that can be presented in relation to the research results above, namely; the result of observation on indicator A, namely; "Exploitation" There are/a small number of students here rarely take advantage of existing information for application development which is the final assignment of lectures, students sometimes seem fixated on the material provided by the lecturer. Then in indicator C namely; The "absorption" students are seen starting to feel comfortable adapting to problems and solving them according to the themes they get, in the next observation in indicator D namely; "Integration" students are good at sharing information and applying it to other colleagues so that problems with one topic can be overcome. In the process this is also related to the E indicator, namely; "Leadership" Students are able to complete their final assignment applications well, students also work hard to solve problems they encounter in coding or reporting difficulties, students are also able to make good decisions in making and developing applications, it can be seen that there are updates beyond the material provided by lecturers, then students are careful and take responsibility for the assigned tasks. Indicator B namely; "Exploration" in the observation of students succeeding in utilizing information and taking advantage of their potential, looking for updates beyond what is given by lecturers and applying them in applications, so that applications can not only be used as assignments but also can be used by the community according to their needs for the application. In other words, the detailed description can be seen in [Figure 1](#).



**Figure 1.** Value of Self Renewal Capacity

Based on Figure 1 the results of the research seen in the description of the qualitative data presented in the two points above, it shows that the PACE learning model applied based on the project based learning model is able to create and increase the value of psychomotor abilities and self renewal capacity, marked by both very good and good criteria. This research is in line with (Afrilianto et al., 2022) that the PACE model can improve students' critical and creative thinking skills so as to add experience and other abilities both in the cognitive, psychomotor or other self-abilities (Afrilianto.M. & Wahyudin, 2019; Pearce & Cline, 2006). The following are some examples of final project applications completed by students, which can be seen in Figures 2, Figure 3 and Figure 4.

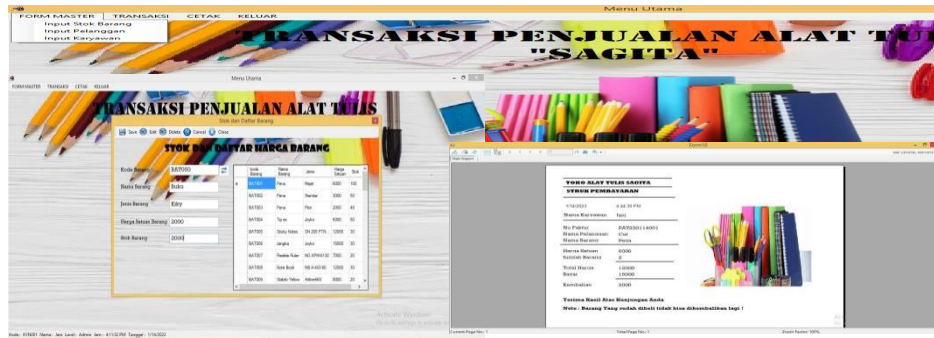


Figure 2. Stationery Sales application

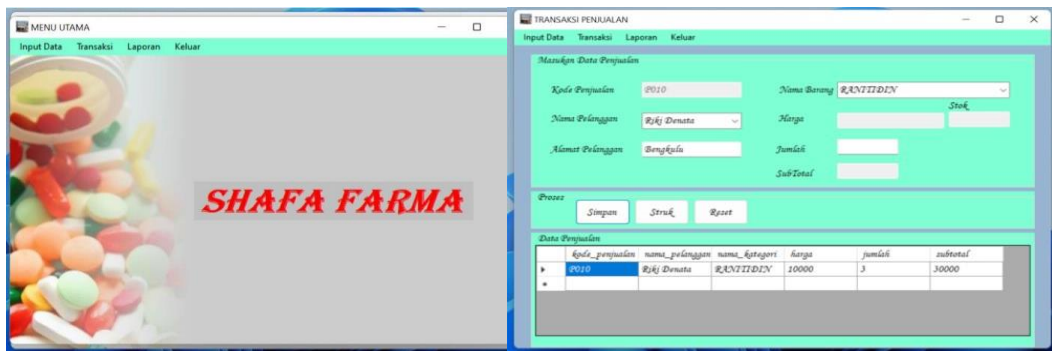


Figure 3. Pharmacy/Medication Sales application

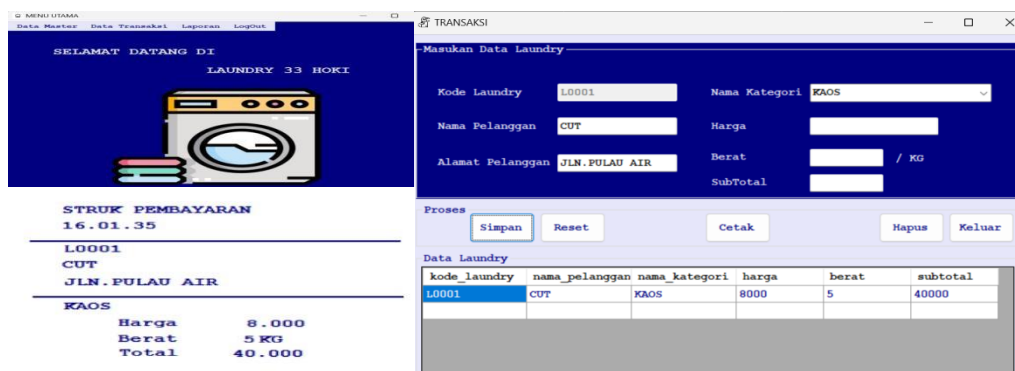


Figure 4. laundry application

## Discussions

In line with the research above, project-based learning itself also has steps that can increase productive competence, including psychomotor, with a percentage of 79.6% whereas in this study with the PACE model based on Project Based Learning can increase psychomotor abilities by 81.2%. The steps that are passed in this model can also create

experiences that are beneficial to the internal and external factors of individual vocational students (Chen.P. & DongJ, 2015; Jalinus et al., 2017). Research by previous study also proves that the project based learning model is effective in increasing student learning achievement, acquiring knowledge through active learning (Howard, 2002), gaining experience, making decisions (Liu.L. & RichmondA, 2005) as well as acquiring good communication skills and useful psychomotor skills (RidloS, 2020).

Psychomotor ability is also one of the abilities that can be improved by students by utilizing the learning model, project based learning or in combination with the PACE model (Plummer et al., 2021; Sumarni.W. et al., 2016). It is in line with research which states that with 2 observed cycles there appears to be an increase in the percentage between cycle 1 and cycle 2 on the ability of students as much as 22% increase (Fadilah.E. & N.d, 2019). Through innovation and the development of approaches in teaching is also a solution to increase psychomotor abilities (Supartini.T. & Hengki, 2020). This is indicated by previous study that psychomotor abilities can also be improved by learning through practicum learning (Astra et al., 2015), which are in accordance with this research with the PACE model based on project based learning which also utilizes teaching practicum methods in computer laboratories (Ananda.R & Yunus, 2017; Mertayasa.I.N.E. et al., 2021). Self-renewal capacity can also be increased through learning models one of which is the PACE learning model. Self-renewal contained in this ability can also be implemented in project based learning learning models which can also improve critical thinking skills creative in solving problems, able to explore potential and able to use it for self-benefit. This is in line with research which states that in reality project based learning research can increase self renewal capacity (Herawati et al., 2023; Sutarsih.C. & SaudUS, 2019), in this case critical thinking by 21.7%, in line with research which add aspects of increasing creativity in self renewal capacity. While in this study with the PACE model based on Project Based Learning can increase self-renewal capacity by 71.7% (Winata.A. & SulistyaningrumH, 2020; Wulandari, 2019). With the comparison that has been described previously, it can be concluded that the PACE model based on Project-based learning can improve psychomotor abilities and self-renewal capacity in informatics engineering education students.

#### **4. CONCLUSION**

Using the PACE learning model based on project based learning in object-oriented programming courses were able to get an average percentage value of students' psychomotor abilities of 81.2% with very good criteria, this is marked by the majority of students can complete their final lecture assignments to make applications and are able to have psychomotor abilities which are a reference for lecturer assessments. Then in this study also looked at the level of achievement of the value of self renewal capacity which is also relevant to psychomotor abilities, so the results of the study found that the average level of value of self renewal capacity was 71.7% with good criteria. This research shows that students as a whole are good at getting to know new things within themselves, exploring potential, utilizing information, generating creative ideas, making decisions, being able to take responsibility for decisions and be thorough in solving problems in lectures and other matters related to the self renewal capacity indicator in this research.

#### **5. ACKNOWLEDGE**

Thank you to the Universitas Putra Indonesia YPTK Padang and FKIP UPI YPTK Padang who have supported the completion of this article and also other related parties with assignment letter number 046/UPI-YPTK/FKIP/ST/VIII/2023.



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