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IMPLEMENTATION OF THE POGIL MODEL ON BLENDED LEARNING TO IMPROVE METACOGNITIVE SKILLS DURING THE COVID-19 PANDEMIC

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Abstract

The purpose of this study is to improve students' metacognitive skills through the application of the Process-Oriented Guided Inquiry Learning (POGIL) model in blended learning in the COVID-19 pandemic era on molecular form materials.
The research method used is experimental quantitative. The research subjects were students of class X IPA 1 SMAN 14 Surabaya. The research data refers to the implementation of learning, observation of student activities, improvement of metacognitive skills and learning outcomes using One Group Pretest and Post-test Design as research designs. Data analysis used percentage, average, n-gain score, normality test, and paired sample t-test.
The results showed that (1) the implementation of learning was categorized as very good with the percentage of each phase of orientation, investigation, concept formation, application, and closure as 92.97%; 84.38%; 93.75%; 93.75%; and 92.71%, (2) students were actively involved in the learning process with a percentage of relevant activities of 93%, (3) students' metacognitive skills increased in three metacognitive dimensions in terms of the n-gain score of 0.74-0.77 in the very good category, and (4) There is a significant difference in the result of metacognitive skills between before and after being given a POGIL model based on blanded learning. The implementation of POGIL model on blended learning in this study as a whole can improve students' metacognitive skills in the era of the COVID-19 pandemic in molecular shape.

Abstrak

Tujuan penelitian ini yaitu untuk meningkatkan keterampilan metakognitif siswa melalui penerapan model *Process-Oriented Guided Inquiry Learning* (POGIL) secara *blended learning* di era pandemi COVID-19 pada materi bentuk molekul.
Metode penelitian yang digunakan yakni kuantitatif eksperimental. Subjek penelitian adalah siswa kelas X IPA 1 SMAN 14 Surabaya. Data penelitian mengacu pada keterlaksanaan pembelajaran, observasi aktivitas siswa, peningkatan keterampilan metakognitif dan hasil belajar menggunakan *One Group Pre-test* dan *Post-test Design* sebagai desain penelitian. Analisis data menggunakan persentase, rata-rata, skor N-gain, uji normalitas, dan uji *paired sample t-test*.
Hasil penelitian menunjukkan bahwa (1) keterlaksanaan pembelajaran termasuk kategori sangat baik dengan persentase fase mengorientasi, menyelidiki, pembentukan konsep, mengaplikasi, dan penutup masing-masing 92,97%; 84,38%; 93,75%; 93,75%; dan 92,71%, (2) siswa terlibat aktif dalam proses pembelajaran dengan persentase aktivitas relevan sebesar 93%, (3) keterampilan metakognitif siswa meningkat pada tiga dimensi metakognitif ditinjau dari skor n-gain sebesar 0.74-0.77 dengan kategori sangat baik, dan (4) terdapat perbedaan hasil yang signifikan antara *pretest* dan *posttest* setelah diterapkannya model POGIL secara *blended learning*. Penerapan model pembelajaran POGIL secara *blended learning* pada penelitian ini secara keseluruhan dapat meningkatkan keterampilan metakognitif siswa di era pandemi COVID-19 pada materi bentuk molekul.

INTRODUCTION

The flow of globalization has changed various aspects of life, one of which is education transformation. The development of the 2013 curriculum as stipulated in Permendikbud No. 36 of 2018 is a transformation effort in the education sector based on the fact that Indonesia's population in 2020-2035 occupies the top position for the population of productive age, reaching 70%. This effort is made to make competent human resources. The refined mindset in the 2013 Curriculum is carried out by strengthening learning patterns through (1) student-centered learning, (2) interactive learning between teachers, students, the environment, and other media, (3) learning networks using the internet, (4) active-seeking learning with a scientific approach, (5) learning with individual and group learning patterns, (6) multimedia-based learning, (7) mass-classical based learning, (8) multidiscipline learning, (9) critical learning (Kemendikbud 2018).

The educational paradigm in the era of globalization has developed following 21st century skills with learning-oriented towards higher-order thinking skills (Badan Standar Nasional Pendidikan 2010). The Regulation of the Minister of Education and Culture in 2016, in line with this, has established competency standards for graduation from primary and secondary education in the dimensions of knowledge, one of which is metacognitive (Kemendikbud 2016). Metacognitive is a higher-order thinking skill and plays a role in making students more independent (Thomas 2012).

Metacognitive skills can be defined as a step taken by a person to improve learning outcomes by being aware of how to learn and how to understand independently, or it can be said to "think about thinking," which means knowledge about how to learn (Flavell 1979; Livingston 2003). Metacognitive skills can be trained in three stages: planning, monitoring, and evaluating (Lai 2011). The three stages are further elaborated through 3 dimensions of metacognition as an organizing variable (Pulmones 2008). Metacognitive skills are very important to develop because they can improve higher-order thinking skills and learning outcomes (Chisholm 1999; Flavell 1979). Cognitive abilities in terms of learning outcomes will increase in line with their metacognitive abilities which are also classified as good (Azizah, et al 2019).

The results of the pre-research conducted at SMAN 14 Surabaya showed that as many as 86.7% of students did not determine their learning goals (planning skills), 56.7% of students did not re-check the information that had been obtained from problem-solving activities (monitoring skills), and 73.3% of students did not review whether they had achieved their learning goals (evaluating skills). The data that has been obtained shows that the students' metacognitive skills are classified as low. This statement is reinforced by other data in the form of students who dislike chemistry as much as 63.3%. The material in chemistry lessons is considered to require a lot of memorization by 56.7% of students. The learning process, which is still teacher-centered, is recognized by 56.7% of students making learning boring with the lecture method. It is not in line with the development of the 2013 Curriculum and 21st century skills where learning must be student-centred, there is an interaction between students, teachers, and the environment, and involves the use of technology (Kemendikbud 2018).

The COVID-19 pandemic that has hit the world and has entered Indonesia has changed the methods and media for implementing learning into 2 approaches, namely distance learning online and offline. The use of technology in the form of gadgets or laptops is a means of online learning, accompanied by several portals and supporting applications provided by the government and schools. In contrast, technology and other teaching materials such as television, radio, student worksheets, and media from objects in the surrounding environment become offline learning facilities (Kemendikbud 2020).

The solution to the situation in the pandemic era in the field of education is to combine online and offline learning or known as blended learning (McGrath 2013; Irwan, et al 2019). Blended learning uses electronic equipment that can contain learning material in the form of digital media and combines two learning conditions, namely online and offline (Husamah 2014). Development of blended learning need an organizational strategy teaching, teaching delivery, and proper teaching quality (Aminah 2020). The application of blended learning is part of electronic learning, technological development, and knowledge delivery in the teaching and learning process (Damayanti & Dwiningsih 2017). Changes in learning into blended learning have been recognized as having a positive impact on students, namely developing self-regulation, increasing learning motivation, and providing

time and opportunity for discussion and reflecting on the knowledge that has been obtained (Al-ani 2013).

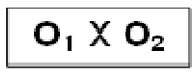
Chemistry is a branch of natural science (science) that contains a lot of discussion about the structure, composition, properties, and changes of matter and its energy (Untoro 2011). The molecular form is a chemical material that requires students to be able to understand theory abstractly, have mathematical skills, conduct experiments, visualize two-dimensional information into three dimensions, and be able to communicate orally and in writing (Jones, et al 2001). The learning model that can support molecular form material is Process-Oriented Guided Inquiry Learning (POGIL).

POGIL is a learning strategy that provides students with opportunities to understand the subject matter and process skills simultaneously (Hanson 2013). POGIL emphasizes the development of cognitive, affective, and psychomotor aspects in a balanced manner to improve student cognitive learning outcomes (Asisul 2016; Mufarohah & Kusumawati 2018). The syntax of POGIL, according to Hanson (2013), consists of 5 stages, namely orientation, investigation, concept formation, application, and closure.

The blended learning POGIL model's application to the molecular form material is divided into two stages, online and offline. Online learning is the initial stage where students will be directed to look for material information on molecular forms based on phenomena and questions in digital worksheets and uploaded to Moodle Learning Management System in SMAN 14 Surabaya. Offline learning is then carried out by utilizing a video conference application to assist students in the teaching and learning process using google meet, WhatsApp group to monitor student discussion interactions, disseminating learning information, and quizizz for test purposes. The blended learning POGIL model teacher acts as a facilitator who accompanies and directs students to discover the concept of molecular form material independently with their groups. This learning design supports students in seeking more comprehensive information by utilizing technology and activities to visualize molecular shapes into three dimensions. This research aims to improve students' metacognitive skills using the POGIL learning model with blended learning on molecular form material, which refers to the implementation of the learning model, learning activities, metacognitive skills, and learning outcomes.

RESEARCH METHOD

This research is a pre-experimental type with only one study group without a control group compared to the One-Group Pretest-Posttest Design. The research was designed by carrying out tests twice, namely pretest before learning was carried out and posttest after the learning process (Sugiyono, 2017). The research subjects were students of class X IPA 1 SMAN 14 Surabaya, totaling 36 students. The research pattern uses the one-group pretest-posttest design according to Sugiyono (2017) as follows:



O_1 = pretest scores of cognitive and skills metacognitive
X = application of the POGIL model in blended learning
O_2 = posttest scores of cognitive and skills metacognitive

The learning tools in this study are the syllabus, the learning implementation plan, and student worksheets. The instruments used include the learning model implementation sheet, student activity sheets, cognitive pretest and posttest question sheets, metacognitive pretest and posttest question sheets, and metacognitive inventory questionnaires that have been reviewed by supervisors and validated by 2 Surabaya State University lecturers. The results of the validation of learning devices reached a value of 94% with a very valid category based on the percentage of validity (Riduwan 2016).

The data collection technique used observation and test method, which was carried out within two meetings. The observation method is carried out on the implementation of the learning model and student activities with validated observation sheets. The test method was carried out using cognitive question sheets in the form of multiple-choice questions and metacognitive question sheets in the form of essay questions.

Analysis of the learning model's implementation will be converted into a percentage. Learning management is effective if it reaches ≥ 61% or is in a good and very good category.

Analysis of student activity is obtained by recording data in the form of time-relevant

activities carried out by students during the learning process. Student activities are carried out well if The percentage of relevant activities > the percentage of irrelevant activities and relevant student activities ≥ 75% (Arifin 2011).

Analysis of cognitive and metacognitive abilities is based on increasing the pretest and posttest scores of these two skills. The increase in the pretest and posttest values is determined based on the N-gain test. Students' cognitive and metacognitive abilities are said to increase if they are included in the moderate to high criteria based on Table 1. the following:

Table 1. N-gain Score Criteria (Hake 1999)

Result	Category
G ≥ 0,7	High
0,3 ≤ G > 0,7	Medium
G < 0,3	Low

The data obtained were then carried out by a normality test using the Shipiro-Wilk test because it only contains 9 to 50 data (Setiawan & Aden, 2020). The t-test was then carried out to determine the difference in the pretest and posttest results.

RESULT AND DISCUSSION

Learning Implementation

Analysis of the implementation of learning aims to determine the quality of implementing the learning process applied by the teacher. Two observers observed POGIL learning implementation by blended learning during two meetings at SMAN 14 Surabaya, to be precise, class X IPA 1 based on the stages written in the lesson plan.

The POGIL model application by blended learning involves using technology in the form of devices or laptops and various supporting applications. It is carried out outside the school hours set by the school at the online learning stage, while modified offline learning is carried out right at the school hours set by the school. It is following the characteristics of blended learning, according to Husamah (2014), namely the use of electronic media by combining online and offline learning conditions.

In this study, the term modified offline learning refers to the type 4 blended learning models, namely enriched virtual, where learning in schools is completely online and then develops a blended program to provide face-to-face experiences to students (Staker 2011).

The form of face-to-face experience used in this study refers to the guidelines for organizing learning from home during the COVID-19 pandemic through a circular from the Ministry of Education and Culture number 15 of 2020 that offline learning can be carried out through worksheets provided by teachers or teaching aids or learning media from the surrounding environment (Kemendikbud 2020). This condition is applied to this study, using student worksheets uploaded through the Moodle SMAN 14 Surabaya and 3D molecular shape props easily found in the environment around the student's house such as plasticine, styrofoam, or other malleable soft materials. Supporting applications other than Moodle are Google Meet, WhatsApp group, and Quizizz.

According to Hanson (2013), blended learning is oriented towards 5 phases of the POGIL model: orienting, investigating, forming concepts, applying, and closing. Data on the results of observations of implementation by 2 observers during 2 meetings are presented in Table 2. the following:

Table 2. Results of The Implementation of The POGIL Model on Blended Learning

Phas	Percentage (%)		Average (%)	Criteria
	M1	M2		
1	90.63	95.31	92.97	Very Good
2	87.50	81.25	84.36	Very Good
3	93.75	93.75	93.75	Very Good
4	93.75	93.75	93.75	Very Good
5	85.42	100	92.71	Very Good

***Note:** M1 = First meeting**;** M2 = Second meeting

The data presented in the table shows that the POGIL model's implementation by blended learning in each phase is ≥ 61% and is in the very good category (Riduwan 2016). These results are in line with research conducted by (Ridlo & Novita 2019) that applying the POGIL model by blended learning is effective in chemistry learning with an average percentage of implementation of 85.1%.

The learning stages of the POGIL model by blended learning are divided into two conditions: online with the POGIL model phase of orienting and investigating, then offline by forming concepts, applying, and closing. The stages carried out are adjusted to the metacognitive dimensions' embodiment, including planning skills, monitoring skills, and evaluating skills (Pulmones 2008).

The orientation phase is carried out by the teacher uploading student worksheets through the Moodle, then providing learning information to students via the WhatsApp group. The convenience found in using the Whatsapp application in learning, that is, students and teachers do not need attend training first (Yuliawati 2021). There was an increase in the implementation percentage in this phase from the two meetings with the very good category. This phase aims to prepare students for learning by providing motivation and raising curiosity through the worksheet's phenomena. In addition, the previous material items were also given to make students connect the knowledge they had obtained. The goal is in accordance with the implemented metacognitive dimension, namely planning skills with the realization of thinking and writing what is known and unknown. It is in line with Ausubel's theory that someone who links initial knowledge with new information obtained makes learning meaningful (Dahar 2011). Other evidence to strengthen Ausubel's theory comes from research (Malik, et al 2017) that students' learning experiences have made it easier to understand the concepts being learned.

The lowest average percentage of the five phases of the POGIL model occurs in phase 2, with a decrease in the percentage from one meeting to another by 6.25%. According to Hanson (2013), this investigating phase leads to learning objectives and provides students with opportunities to observe, analyze and collect information, and make investigative relationships that lead to proposed questions or hypothesis testing. These objectives are following the metacognitive dimensions of planning skills in identifying to obtain information. The additional learning videos influenced the decrease in the percentage of implementation at the second meeting, which required students to make observations. This activity certainly takes more time than just answering questions and seeking the information in the first meeting. One of the shortcomings of the POGIL model, according to (Zawadzki 2010) is the problem of time that has not been appropriately allocated and student discipline in implementing the learning process.

The concept formation phase is the initial stage of offline learning carried out right at the school hours set by the school. This phase is the result of investigations in the previous phase. The process that occurs is by providing questions that force students to think critically and understand the concepts learned through question items about the steps to determine the shape of a molecule using VSEPR Theory and Electron Domain Theory. The concept formation phase's objectives are oriented to the metacognitive dimension of monitoring skills through repeated material reading, making important notes, and consulting references. The late results obtained in this phase were classified as very good, with an average percentage of 93.75%. At the offline learning stage, all activities carried out by students are done in groups. According to (Tawil & Liliasari 2013) critical thinking skills can be developed using cooperative methods and collaborative problem solving between students who are actively involved in groups.

The advanced phase of concept formation is applied. This phase involves new knowledge that has been identified, strengthened, and expanded in the form of simple exercises and practical exercises to create 3D molecular shapes from materials in the surrounding environment. The implementation of offline learning involves the teacher as a facilitator who accompanies students during the learning process and discussions through the Google Meet video conference. At this stage, the metacognitive abilities trained are still in the dimension of monitoring skills to review solutions from examples of problems and solve additional problems. The percentage of implementation results is in the very good category. These results are in line with Bruner's statement in (Widyaningsih, et al 2012) that students become more aware of the concept if they experience directly and participate actively to gain experience through experimental activities or other processes that liberate.

Student Activity

Observation of student activities aims to determine how students carry out activities during the learning process with the POGIL model in blended learning. Observation of student activities is carried out in 2 lessons by three observers where each observer will observe each of the two groups. Student activities are observed every 3 minutes, according to the learning stages of the POGIL model. Observations were made in two stages which were adapted to blended learning, namely online and offline. Online learning activities were observed by recapping Moodle activities and through student interaction in each WhatsApp group that had been provided. Offline learning activities were observed through the Google Meet video conference and WhatsApp group. There are two types of activities that are

observed by 3 observers, namely relevant and irrelevant activities. Relevant activities are a manifestation of metacognitive skills based on the POGIL syntax in blended learning which includes accessing and observing phenomena or learning videos that have been uploaded on Moodle, writing down information obtained from phenomena, submitting answers to oriented or planning activities, discussing with groups via WhatsApp groups, responding teachers during learning through Google Meet video conferences, submitting answers from monitoring and evaluation activities, and presenting the results of group discussions.

Student activity is very important to know because it will affect the process of understanding the concept. It is in line with the opinion (Parameswari & Azizah 2020) that students must be actively involved in relevant learning process activities to construct their knowledge. The percentage of observations of student activities through the POGIL model by blended learning is presented in the circle diagram in Figure 1. below:

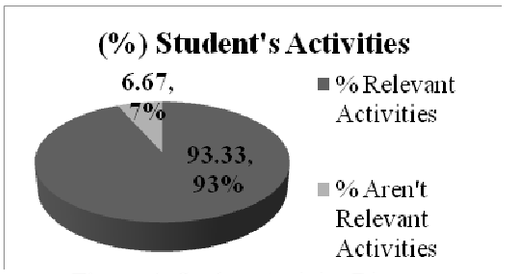


Figure 1. Student Activity Diagram

The diagram above shows that the activities carried out by students are 93% relevant to learning activities, so it is concluded that students are active during learning activities with the POGIL model by blended learning on molecular form material.

Metacognitive Skills

Metacognitive skills include planning skills, monitoring skills, and evaluating skills (Pulmones, 2008). This skill was chosen because it is a higher-order thinking skill and makes students more independent (Thomas 2012). The existence of analysis, synthesis, and evaluation elements as the beginning of the development of inquiry abilities and creativity make metacognitive skills part of higher-order thinking (Schraw & Moshman 1995). Metacognitive skills that are part of higher-order thinking skills are needed in the 21st century (Amtu, et al 2021). These skills are trained through observing phenomena and learning videos, working on student worksheet sheets, group discussions to find the concept of molecular shapes, and doing simple practicum making molecular shapes. 3D objects in the environment. All activities and learning tools are oriented to metacognitive skills. It is in line with the statement (Parlan, et al 2018) that a learning device that uses metacognitive strategies can effectively improve thinking skills from low to high levels.

Data on the improvement of metacognitive skills were obtained through two tests, namely the pretest before learning activities and the posttest after the learning process, where both tests were carried out outside of learning hours. The test questions consist of 5 items with 3 metacognitive dimensions are planning skills, monitoring skills, and evaluating skills. Students are asked to work on test questions for 90 minutes through the Quizizz application. Students' answers are corrected by giving a score that depends on the answer keywords that have been formulated in the assessment rubric. The answer score is then converted into a 10-100 scale value. The results of the posttest and pretest assessments of metacognitive skills are presented in the bar chart in Figure 2 below:

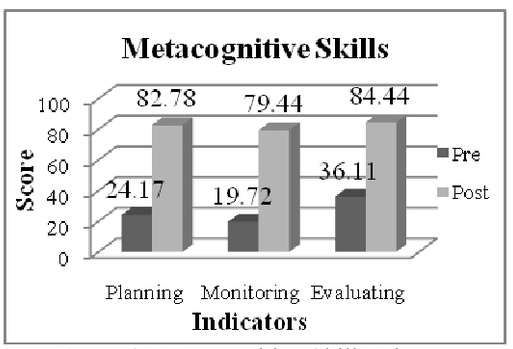


Figure 2. Metacognitive Skills Diagram

The bar chart above shows that the average posttest score is greater than the pretest value, which means there is an increase. It indicates that students' answers have met the criteria that involve the metacognitive skill dimension. This data is in line with research conducted by (Rahmawati & Sugiarto 2014) that applying the POGIL model to chemical materials can improve metacognitive skills in three dimensions, namely planning monitoring skills and evaluating skills. This increase is in line with the results of student implementation and activities where conceptual understanding occurs due to social interactions and discussions that

encourage or trigger students' cognitive development (Slavin 2018).

The N-gain index then calculates the data on the increase in the value of the metacognitive skills test, the results of which are shown in the bar chart in Figure 3. as follows:

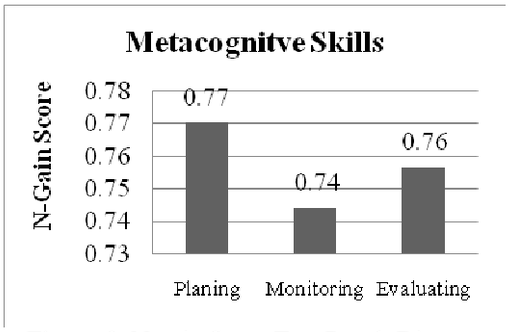


Figure 3. N-gain Score Test Result Diagram

The bar chart above shows that the n-gain score obtained from the metacognitive skills test results ranged from 0.74-0.77, which is high (Hake 1999). The n-gain score data is then tested for normality using the Shapiro Wilk test because it only contains 9 to 50 data (Setiawan & Aden 2020). The normality test aims to determine the distribution of data in a group with normal or abnormal criteria. The data distribution is normal if the pretest and posttest scores have a sig> 0.05 (Sugiyono 2017). The results of the pretest and posttest normality test scores are presented in Table 3. the following:

Table 3. Results of Normality Test of Metacognitive Skills

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre-test	0.106	36	.200*	0.952	36	0.125
Post-test	0.160	36	0.020	0.958	36	0.191

The result of the normality test shown in the table above is that the pretest score has sig. 0.125 and the posttest score shows the sig value. 0.191 so it can be concluded that the research data is normally distributed. Then the paired sample t-test was carried out to determine the effect of applying the POGIL model by blended learning on the pretest and posttest of students' metacognitive skills. The following Table 4. shows the results of the paired sample t-test.

Table 4. Results of Paired Sample t-Test Metacognitive Skills

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Pre-test Metakognitif - Post-test Metakognitif	-55.556	6.66738	1.112	-57.8115	-53.2996	-49.995	35	0.000

The paired sample t-test is said to have a significant difference if the sig. (2-tailed) value <0.05 (Sugiyono 2017). The table above shows the sig. (2-tailed) value of <0.001, which means less than 0.05, so it is said that there is a significant difference between the pretest and posttest scores of metacognitive skills after the POGIL model is applied by blended learning.

Analysis of learning outcomes is also carried out to determine students' cognitive abilities through increasing the pretest and posttest scores. In this study, the average pretest and posttest cognitive scores were 32.22 and 80, respectively. In this study also obtained the average pretest and posttest cognitive scores, respectively 32.22 and 80. The data was then analyzed using the n-gain index calculation, where the results showed a value of 0.71 in the high category. It is in line with the research conducted (Sudjana & Wijayanti 2018) that the increase in metacognitive skills in chemical materials affects the percentage of students who achieve minimum completeness criteria scores in 2 cycles, respectively 66.02% and 84.38%. Cognitive abilities in terms of learning outcomes will increase in line with their metacognitive abilities which are also classified as good (Azizah, et al 2019).

CONCLUSION

Based on the objectives and results of this study, it can be concluded that: (1) the application of the POGIL model using blended learning to improve students' metacognitive skills is carried out well as evidenced by the average percentage of implementation phases of orientation, investigation, concept formation, application, and closure as92.97% each; 84.38%; 93.75%; 93.75%; and 92.71%, (2) students are actively involved in the learning process with the percentage of relevant activities greater than irrelevant activities, namely 93%>7%, (3) students' metacognitive skills increase in three metacognitive dimensions in terms of the n-gain score of 0.74-0.77, in terms of normality test for pretest and posttest, each of which shows a sig value. 0.125 and 0.191, in terms of the paired sample t-test, shows the sig. <0.001, and (4) There is a significant difference in the result of metacognitive skills between before and after being given a POGIL model based on blended learning.

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