
Improvement of elementary science learning outcomes using guided experimentation method

Nur Lailia Swadika Putri, Romia Hari Susanti*, Martini Dwi Purnama

Universitas PGRI Kanjuruhan Malang, Jl. S. Supriadi No. 48, Malang, Jawa Timur, 65148, Indonesia

e-mail: romi@unikama.ac.id

* Corresponding Author.

Received: 21 November 2023; Revised: 26 December 2023; Accepted: 31 December 2023

Abstract: This research aimed to increase students' conceptual understanding of photosynthesis in science subject through the stages of initial experimentation, observation, hypothesis preparation, verification, and application of the concept in experimental methods. The researchers investigated how science learning on photosynthesis using experimental methods could improve student learning outcomes. This research employed a classroom action research as a type of research. The research design followed the Kemmis and Mc Taggart model that was composed of four stages in each cycle: planning, implementation, observation, and reflection. Data collection instruments included observation sheets, learning outcome tests, and documentation. The research began with the pre-cycle and followed by cycles I and II. The research findings showed that student learning outcomes could be improved through the use of experimental methods in photosynthesis and science subject. This was supported by an increase in percentage results from pre-cycle (18%), cycle I (56%), and cycle II (78%). Therefore, it could be concluded that the experimental method was able to improve the learning outcomes of grade IV students at SDN Gadang 1 Malang City in the science subject of photosynthesis.

Keywords: science subjects; experimental method; photosynthesis; learning outcomes

How to Cite: Putri, N. L. S., Susanti, R. H., & Purnama, M. D. (2023). Improvement of elementary science learning outcomes using guided experimentation method. *Journal of Environment and Sustainability Education*, 1(2), 72-79. Retrieved from <https://joease.id/index.php/joease/article/view/19>

Introduction

Science learning is a concept of natural learning that has complex relevance to all human activities. Science education itself is not just about memorization; it requires an understanding of the concepts of the subject matter. This aligns with the requirements of science learning in elementary schools, where the goal is to enhance insight and understanding of scientific concepts that are useful and applicable in everyday activities (Basonggo et al., 2014). When teaching science, it is essential for teachers to apply more innovative methods to help students absorb the material comprehensively. One method that teachers can employ to provide direct experience and enhance students' learning skills is the experimental method. Learning activities that utilize the experimental method allow students the opportunity to independently conduct experiments, follow procedures, observe, analyze, verify, and draw conclusions on their own regarding an object, situation, or process (Haniyah et al., 2021). It can be said that science education cannot be separated from observational methods or experimental methods.

The experimental method is highly suitable for science learning, which requires students to engage in guided observation or exploration. Guided experimental methods involve experiments that have been designed by the teacher before the students conduct them. This includes specifying the steps of the experiment, the equipment to be used, and what needs to be observed and measured—

all predetermined from the outset (Suparno, 2007). One of the materials considered complex and abstract for students is the topic of photosynthesis (Wahidah et al., 2018). With the assistance of the experimental method that involves students working individually or in groups, students find it easier to comprehend the material (Agustiningsih, 2014). The positive impact of the experimental method on learning includes more meaningful learning, increased student engagement, and the achievement of optimal learning outcomes (Guntur et al., 2022). Findings from research conducted by Anti in 2021 concluded that students' learning outcomes can improve through the use of the experimental method, particularly in the context of the photosynthesis topic (Anti, 2021).

Photosynthesis is a learning material that requires a mastery of concepts in the understanding of IPAS (Science and Social) elements, which is considered challenging for students. This difficulty arises because the process and outcomes of photosynthesis cannot be observed with the naked eye (Wahidah et al., 2018). It is not uncommon for students to have misconceptions about the photosynthesis material (Dwilestari & Desstya, 2022). In this case, students may struggle to identify the components involved in photosynthesis, understand the outcomes of photosynthesis, determine the function of leaves, and relate the impacts of the photosynthesis process to other living organisms. The role of the teacher is crucial in improving the learning process of complex and abstract science subjects, and one effective approach is the use of the experimental method.

Based on the observations conducted on July 24, 2023, and July 26, 2023, in grade IV at SDN Gadang 1 Malang City, it was found that there was a lack of implementation of the experimental method in the teaching and learning process, leading to low achievement in the science subject. Teachers tended to apply conventional teaching methods in each lesson. Additionally, students' understanding of the photosynthesis material was also low. As a result, students became disengaged, less focused, and lose interest in learning. An interview with the grade IV teacher at SDN Gadang 1 Kota Malang on July 27, 2023, revealed that the photosynthesis material was indeed challenging for students due to the presence of new terms that they had not encountered before. Furthermore, the results of the pre-test on the photosynthesis material conducted on July 31, 2023, showed that out of 27 students, only 5 students were able to achieve passing grades. The pre-test results indicated that 22 students had not yet mastered the photosynthesis material.

Based on several relevant previous studies, it had been found that the positive utilization of the experimental method had an impact on students' learning outcomes. A study conducted by Anti in 2021 indicated an average increase in student learning outcomes of up to 90% through the implementation of the experimental method (Anti, 2021). Another study by Juita in 2019 stated that using the experimental method in science learning activities could raise the average learning outcomes score to 77.6%, with a student completion rate of 90% (Juita, 2019). However, the research conducted by the current researcher had significant differences from previous studies, particularly in terms of the research subjects and the modified experimental activities.

The advantage of this experimental method is that it allows students to more easily understand the topic by experiencing and proving the theories they investigate. The advantages of the experimental method (Juita, 2019) include: 1) It can increase students' confidence in the truth and conclusions they draw based on their independent experiment results, compared to just accepting the teacher's or the book's words; 2) It develops students who will make discoveries from experiments and recent findings that are useful to human life; 3) Valuable findings from experiments will be used for the welfare of humanity. Based on the explanations provided earlier, it can be concluded that there is a need for improvement in increasing students' learning outcomes in photosynthesis using the experimental method. Therefore, the researcher intends to conduct a study with the title "Improvement of Elementary Science Learning Outcomes Using Guided Experimentation Method in Grade IV Students at SDN Gadang 1 Malang City." The background for this research is to enhance science learning outcomes in the photosynthesis material through the use of the experimental method for grade IV students at SDN Gadang 1 Malang City.

Method

This research adopted the Classroom Action Research (Penelitian Tindakan Kelas or PTK) method, in line with its characteristics of addressing issues during classroom learning practices (Basonggo et al., 2014). Furthermore, many teachers in schools often conducted Classroom Action Research because the subjects of their research were students (Susilowati, 2018). The aim of this study was to enhance the learning outcomes in science, specifically the photosynthesis material, by implementing the experimental method for grade IV students at SDN Gadang 1 Malang City. According to Hamdayana (2016), the experimental method was an instructional presentation in which students engaged in experiments, experiencing firsthand what they learn through stages such as initial experimentation, observation, hypothesis formulation, verification, and concept application. The research was conducted in the first semester of the 2023/2024 academic year. The research subjects consisted of grade IV students (15 male and 12 female) from SDN Gadang 1 Malang City.

The research model utilized was the design devised by Kemmis and McTaggart, consisting of four components (Hendawati & Kurniati, 2017): planning, action, observation, and reflection. Data coding techniques involved observation, documentation, and learning outcome test sheets. The observation sheet was used to measure the teacher's performance and students' learning activities when using the experimental method. The learning outcome test sheet was used at the end of cycles I and II to measure the level of improvement in students' cognitive learning outcomes. The learning outcome test was created based on the guidelines of the learning outcome test item grid, using a multiple-choice question format. Documentation served as a record of a particular activity or event and reinforced the gathered data. During the research, documentation in the form of videos and photos was collected throughout the learning process.

The information obtained from this research comprised two types of data: quantitative and qualitative. Qualitative data was in the form of explanations through words, while quantitative data was in the form of numerical data. The data analysis process in this classroom action research was conducted after obtaining the students' learning outcomes and observation sheets. The data analysis in this research employed a comparative descriptive technique, where the information obtained was compared between cycle I and cycle II (Janah et al., 2019). The results of the data analysis were presented in percentage form by calculating the students' learning outcome completeness. To achieve completeness, students had to meet the minimum criteria set, namely the Minimum Completeness Criteria (Kriteria Ketuntasan Minimal or KKM) score of 70.

Results and Discussion

Pre-Cycle

The pre-cycle was conducted before implementing the classroom action by conducting observation activities during the learning process. The observation results indicated that the teaching method was still conventional, leading to low science subject scores. The learning process mainly relied on the textbook and teacher lectures, causing students to speak among themselves and lose focus during the lesson. The researcher conducted a pretest for 27 Grade IV students at SDN Gadang 1 Malang City on the topic of photosynthesis. The pretest aimed to understand the students' initial capabilities regarding the photosynthesis material. The completeness scores obtained by students after the pretest are shown in Table 1 below.

Table 1. Pretest Results of Grade IV Students at SDN Gadang 1 Malang City

The number of students	Score	Percentage (%)	Description
≥70	5	18%	Complete
<70	22	82%	Not Complete
Total	27	100%	
Average Score		52,3	

Source: Janah, Sulasmono & Setyaningtyas (2019)

In Table 1 above, the data explained the results of the pretest for grade IV students at SDN Gadang 1 Malang City in the science subject, specifically the topic of photosynthesis. The table indicated that out of a total of 27 students, only 5 students successfully completed the pretest, while the remaining 22 students did not complete it. The percentage of completeness for students in the pre-cycle stage was 18%, and those who did not complete it were 82%. The average score obtained by students in the pretest was 52.3. This condition indicated that the initial level of students' understanding of the photosynthesis material was still very low, highlighting the need for improvement through the use of the experimental method in teaching.

Cycle I

In the cycle I conducted on Monday, August 7, 2023, in grade IV at SDN Gadang 1 Malang City, the topic covered was the photosynthesis material, with a time allocation of 3 sessions or 3 × 35 minutes. The first step taken was the planning stage of the action, which was carried out by the researcher based on intensive discussions with the classroom teacher. The researcher discussed the preparation of a teaching module to be applied in the classroom. The teaching module created applied the discovery learning model. The module also included instructional materials, student worksheets (Lembar Kerja Peserta Didik or LKPD), teaching aids, evaluation questions, and their guidelines, which were used as a post-test to measure the students' capabilities after the treatment in the cycle I, and an assessment sheet.

The implementation of the teaching was adjusted based on the preparation of the teaching module that had been developed in the planning stage. The action taken by the researcher was to use the experimental method with the aim of improving student learning outcomes. Referring to the observation results of the teaching implementation, it was found that the use of experiments successfully created enthusiasm and interest among students in learning. This made it easier for students to understand the material. The experimental method required easily accessible tools and materials such as fresh leaves, plastic cups, and water. These tools and materials were used in one study group. Students were very enthusiastic during the practical process, although some students still lost focus during the ongoing learning.

The next stage was the reflection stage, where the researcher and the classroom teacher reflected based on the implementation of the teaching that had taken place. This reflection was aimed at evaluating the teaching process and determining the subsequent steps to be taken. Based on the results of the learning outcome test in the cycle I, it was found that some students were still not fully engaged in the learning process. Some students still faced difficulties in answering evaluation questions. The learning outcomes of students in the implementation of teaching using the experimental method on the topic of photosynthesis are explained in Table 2 below.

Table 2. Learning Results of Grade IV Students at SDN Gadang 1 Malang City Cycle I

The number of students	Score	Percentage (%)	Description
≥70	15	56%	Complete
<70	12	44%	Not Complete
Total	27	100%	
Average Score		63,7	

Source: Janah, Sulasmono & Setyaningtyas (2019)

Based on Table 2 above, the implementation of the experimental method in the cycle I showed an improvement in the learning outcomes of grade IV students at SDN Gadang 1 Malang City. A total of 15 students successfully achieved completeness, while 12 students still did not complete it. This improvement was significant compared to the previous cycle, which only had 5 students who reached completeness. Similarly, the average score of students increased from 52.3 in the pre-cycle to 63.7 in cycle I. The completeness percentage increased from 18% in the pre-cycle to 56% in cycle I. Although there was an improvement, the results obtained were still below the planned target. Therefore, the

researcher collaborated with the classroom teacher to proceed to cycle II and make improvements to cycle I, with the hope of achieving a significant improvement in student learning outcomes.

Cycle II

In the cycle II conducted on Friday, August 11, 2023, in grade IV at SDN Gadang 1 Malang City, the topic covered was the photosynthesis material, with a time allocation of 3 sessions or 3 × 35 minutes. In this cycle, the learning activities were a manifestation of improvements from the shortcomings in the previous cycle. The researcher, together with the classroom teacher, held intensive discussions to improve the teaching in cycle II. The reflection results indicated that during the practical work, students tended to work individually and did not observe correctly. Therefore, in cycle II, the researcher established classroom rules and educational games to ensure that students were more disciplined during the practical work. The educational games were conducted after the practical work, consisting of questions related to the photosynthesis material.

The first step taken was action planning, conducted by the researcher based on intensive discussions with the classroom teacher. The researcher discussed the preparation of teaching modules that would be applied in the classroom, similar to cycle I. However, the competency achievement indicators were slightly developed. In cycle I, observing the process of photosynthesis using fresh leaves could produce light. In cycle II, observing the influence of sunlight and carbon dioxide on aquatic plants, namely hydrilla, in the process of photosynthesis could produce oxygen.

The implementation of the learning process in cycle II was adjusted based on the preparation of the teaching modules made during the planning stage. This implementation was carried out based on the results of discussions with the classroom teacher. According to the observations made during the implementation of the learning process in cycle II, it was found that using the experimental method made students more enthusiastic, interested in learning, and actively involved during the practical work. This occurred because, at the beginning of the learning process, students were given classroom agreements that made them more disciplined and earnest in conducting practical work. In cycle II, students also found it easier to understand the photosynthesis material as they were assisted by playing educational games containing questions about the photosynthesis material during the practical work.

The final stage was the reflection stage, where the researcher, along with the classroom teacher, conducted reflection based on the implementation of the applied learning process. Based on the improvements made, the students' learning outcomes in cycle I increased in cycle II. The student learning outcomes in cycle II, utilizing the experimental method in the photosynthesis material, could be seen in Table 3 below.

Table 3. Learning Results of Grade IV Students at SDN Gadang 1 Malang City Cycle II

The number of students	Score	Percentage (%)	Description
≥70	21	78%	Complete
<70	6	22%	Not Complete
Total	27	100%	
Average Score		83,3	

Source: Janah, Sulasmono & Setyaningtyas (2019)

Through Table 3, it could be observed that in the implementation of cycle II using the experimental method, the learning outcomes of grade IV students at SDN Gadang 1 Malang City experienced a significant increase. The number of students who passed increased from 15 in cycle I to 21 in cycle II. The average score of students also increased, from 63.7 in cycle I to 83.3 in cycle II. The percentage of completeness increased from 56% in cycle I to 78% in cycle II. These results indicated that the application of the experimental method in cycle II had a more positive impact compared to the previous cycle.

Discussion

The research results during the implementation of science teaching on the topic of photosynthesis through the application of the experimental method obtained data from the pre-cycle, cycle I, and cycle II. Observations of the learning outcomes recorded an increase in the average scores, starting from 52.3 in the pre-cycle, rising to 63.7 in cycle I, and further increasing to 83.3 in cycle II. This reflected a significant improvement in student learning outcomes during the implementation of the experimental method. Furthermore, a comparative presentation of student learning completeness from the pre-cycle, cycle I, and cycle II could be found in Table 4 below.

Table 4. Comparison of Learning Outcomes of Grade IV Students at SDN Gadang 1 Malang City

Completeness	Pre-Cycle		Cycle I		Cycle II	
	Complete 5 students	Not Complete 22 students	Complete 15 students	Not Complete 12 students	Complete 21 students	Not Complete 6 students
Percentage	18%	82%	56%	44%	78%	22%
Quantity	27 students		27 students		27 students	
Average	52,3		63,7		83,3	

Source: Masus & Fadhilaturrehmi (2020)

Based on the data in the table above, it could be concluded that after the improvement, there was an increase in the completeness of learning outcomes and the percentage compared to the cycle I and pre-cycle. The completeness percentage increased from 18% in the pre-cycle to 56% in the cycle I. The improvement continued from 56% in the cycle I to 78% in the cycle II. With this, it could be stated that students achieved satisfactory learning outcomes. The selection of teaching methods should have been tailored to the material and students' conditions so that the method used could stimulate students' interest in the taught material (Wibowo et al., 2019). Therefore, the use of the experimental method in teaching the photosynthesis material for grade IV at SDN Gadang 1 Malang City could be concluded after the cycle II as it had met the targeted success indicators. The percentage of student learning outcomes in science, particularly in the photosynthesis material, for grade IV at SDN Gadang 1 Malang City could be observed from the data presented in the following graph.

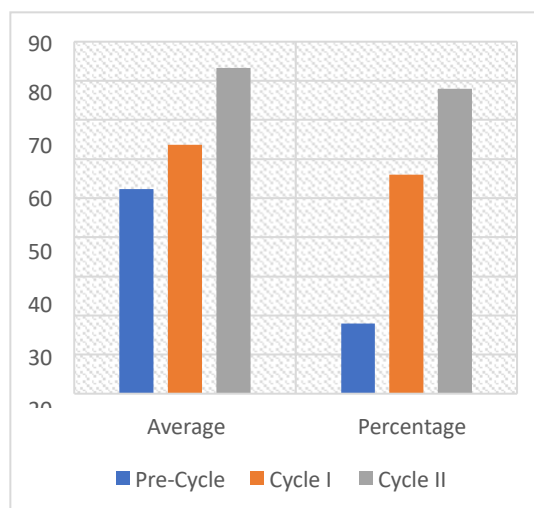


Figure 1. Comparison Graph of Grade IV Student Learning Results at SDN Gadang 1 Malang City

Based on the graph above, the comparison of learning outcomes for grade IV students at SDN Gadang 1 Malang City indicated an increase in average scores and the percentage of learning outcome completeness. It could be seen that learning through the experimental method in the topic of photosynthesis could be considered successful because the expected success indicators had been met. Therefore, it could be concluded that the experimental method in science learning, particularly in the photosynthesis material, could serve as a solution to address the issue of low student learning

outcomes. The experimental method was an instructional approach that guided students to independently conduct experiments on the concepts they were learning (Amalia et al., 2018). Learning through the experimental method provided an opportunity for students to discover concepts on their own through observation using logical reasoning, creative thinking, and effective problem-solving skills (Oviana, 2013). The use of the experimental method in teaching provided students with the opportunity to observe an object, analyze, prove, and draw their own conclusions about it (Masus, 2014). This finding was supported by previous research conducted by Anti in 2021, which indicated that the implementation of the experimental method could improve the average student learning outcomes by 90% (Anti, 2021). Another subsequent study that supported these findings was the research conducted by Juita in 2019, which showed that the experimental method in science learning could increase the average learning outcomes score by 77.6%, with a student completion rate of 90% (Juita, 2019). The research conducted by Rukinem (2018) revealed that the use of the experimental method could make students more active, resulting in an improvement in student learning outcomes. Therefore, the implementation of the experimental method was stated to enhance student learning outcomes in the science subject of photosynthesis.

Conclusion

Based on the research results, the implementation of science learning on the topic of photosynthesis in grade IV at SDN Gadang 1 Malang City could be applied through the implementation of the experimental method. This research had an impact on improving student learning outcomes, as evidenced by the pre-cycle, cycle I, and cycle II. The analysis of the data obtained in the pre-cycle showed that students only achieved a learning completeness of 18%, and there was an improvement in cycle I by 56%, continuing to increase by 78% in cycle II. Therefore, it could be concluded that the experimental method successfully enhanced students' learning outcomes in science learning on the topic of photosynthesis in Grade IV at SDN Gadang 1 Malang City.

References

- Agustiningasih. (2014). Peningkatan Aktivitas dan Hasil Pembelajaran IPA Sekolah Dasar Melalui Metode Eksperimen. *Jurnal Pedagogi* Vol.1 No.1, 47-55.
- Amalia, K., Saparahayuningsih, S., & Suprapti, A. (2018). Meningkatkan Kemampuan Sains Mengenal Benda Cair Melalui Metode Eksperimen. *Jurnal Ilmiah POTENSIA*, 3(2), 1–10.
- Anti, W. M. (2021). *Penerapan Metode Pembelajaran Eksperimen untuk Meningkatkan Keaktifan dan Hasil Belajar IPA pelaksanaan pembelajaran IPA materi fotosintesis di kelas IV SDN Gadang 1 Kota Malang IPA Kelas IV MI Darwata Karangjati 02* (Doctoral Dissertation, Universitas Nahdlatul Ulama Al-Ghazali Cilacap).
- Basonggo, I., Tangkas, I. M., & Irwan, I. (2014). Meningkatkan Hasil Belajar Siswa Melalui Metode Eksperimen dalam Pembelajaran IPA di Kelas V SDN Meselese. *Jurnal Kreatif Online*, 2(2).
- Dwilestari, D., & Desstya, A. (2022). Analisis Miskonsepsi pada Materi Fotosintesis dengan Menggunakan Peta Konsep pada Siswa Sekolah Dasar. *Jurnal Basicedu*, 6(3), 3343-3350.
- Guntur, Zainal, & Yusmira. (2022). Penerapan Metode Eksperimen Dalam Meningkatkan Hasil Belajar Siswa Kelas IV SD. *Pinisi Jurnal PGSD UNM*, 2(1). <https://doi.org/10.26858>.
- Hamdayana, J. (2016). *Metodologi Pengajaran*. Jakarta: Bumi Aksara.
- Haniyah, L., Bektiarso, S., & Wahyuni, S. (2021). Model Pembelajaran Kooperatif Tipe NHT (Numbered Head Together) Disertai Metode Eksperimen Pada Pembelajaran IPA Fisika SMP. *Jurnal Pembelajaran Fisika FKIP Universitas Jember*, 3(1). <https://doi.org/10.19184/jpf.v3i1.23239>.
- Hendawati, Y., & Kurniati, C. (2017). Penerapan Metode Eksperimen Terhadap Pemahaman Konsep Siswa Kelas V Pada Materi Gaya Dan Pemanfatannya. *Metodik Didaktik: Jurnal Pendidikan Ke-SD-an*, 13(1).
- Janah, F. N. M., Sulasmono, B. S., & Setyaningtyas, E. W. (2019). Peningkatan Hasil Belajar Matematika Melalui Model Pembelajaran Problem Based Learning Berbantuan Media Video Siswa Kelas IV SD. *Jurnal Pendidikan Dasar*, 7(1).
- Juita, R. (2019). Meningkatkan Hasil Belajar IPA Melalui Metode Eksperimen Pada Siswa Kelas IV SDN 02 Kota Mukomuko. *IJIS Edu: Indonesian Journal of Integrated Science Education*, 1(1), 43-50.

- Hudha, M. N., Aji, S. D., & Huda, C. (2018). E-Rubric: Scientific Work Based on Android for Experimental Physics IOP Conf. Ser. Mater. Sci. Eng. 288 1.
- Masus, S. B., & Fadhilaturrahmi, F. (2020). Peningkatan Keterampilan Proses Sains Ipa Dengan Menggunakan Metode Eksperimen Di Sekolah Dasar. *Jurnal Pendidikan Dan Konseling (JPDK)*, 2(2), 161-167.
- Oviana, W., & Maulidar. (2013). Penggunaan Metode Eksperimen Pada Pembelajaran Materi Sifat Bahan Dan Kegunaannya Terhadap Hasil Dan Respon Belajar Siswa Kelas IV Min Tungkob Aceh Besar. *Jurnal Ilmiah DIDAKTIKA* Februari 2013 VOL. XIII, NO. 2, 336-350.
- Rukinem, R. (2018). Penggunaan Metode Eksperimen untuk meningkatkan Hasil Belajar Siswa tentang Cahaya di Kelas V SDN 07 Silaut Kecamatan Silaut. *JPPi (Jurnal Penelitian Pendidikan Indonesia)*, 4(1), 34.
- Solikati, N. (2021). Peningkatan Prestasi Belajar IPA Materi Rangkaian Listrik Sederhana Dengan Metode Eksperimen. *Jurnal Terapan Pendidikan Dasar Dan Menengah*, 1(2). <https://doi.org/https://doi.org/10.28926/Jtpdm.V1i1.1>.
- Suparno, P. (2007). *Metodologi Pembelajaran Fisika Konstruktivistik dan Menyenangkan*. Yogyakarta: Universitas Sanata Dharma.
- Susilowati, D. (2018). Penelitian Tindakan Kelas (PTK) Solusi Alternatif Problematika Pembelajaran. *Jurnal Imiah Edunomika*. <https://doi.org/10.29040/jie.v2i01.175>.
- Wahidah, N. S., Supriatno, B., & Kusumastuti, M. N. (2018). Analisis Struktur dan Kemunculan Tingkat Kognitif pada Desain Kegiatan Laboratorium Materi Fotosintesis. *Assimilation: Indonesian Journal of Biology Education*, 1(2), 70.
- Wibowo, A., & Budi, G. S. (2019). Penerapan Metode Eksperimen pada Materi Zat dan Karakteristik di Kelas VII SMP Muhammadiyah Palangka Raya. *Jurnal Pendidikan Sains*. Universitas Palangka Raya, 1(2): 32-38.