HOME-BASED EXPERIMENT: STUDENTS' RESPONSES ABOUT INDEPENDENT PRACTICUM AT HOME DURING ONLINE LEARNING

HOME-BASED EXPERIMENT: RESPON SISWA TENTANG PRAKTIKUM DI RUMAH SELAMA PEMBELAJARAN ONLINE

Nanda Syah Putra[1*)], Desi Desmiawati[2)]
Science Education Department, Universitas Pendidikan Indonesia, West Java, Indonesia,
email: [1*)]nandamursamad@upi.edu (corresponding author), [2)]desid1982@upi.edu

Submitted: September 2022; Approved: January 2023; Published: May 2023

Abstract

This study aimed to reveal students' responses to the implementation of home-based experiments on photosynthesis materials. The research sample consisted of 1 class that implemented home-based experiment learning, with the number of students involved being 26 students, which was determined using convenience sampling technique.The student response measurement scale used the Guttman scale, which demanded an unequivocal answer from the student to the given question. Students were given a choice of "yes" or "no" answers. Student response questionnaires consisted of 3 aspects, namely students' attitudes toward home-based experiment learning, students' interest in home-based experiment learning, and student's understanding of learning materials after home-based experiment learning. Based on the student practicum report related to the success of carrying out the practicum as evidenced by the drawings of the observation results, the application of home-based experiments by carrying out the Sach experiment practicum showed satisfactory results where in general students completed experimental activities well. Then, the application of home-based experiments received a positive response from students which could encourage the improvement of student cooperation ability, student independent ability, and student enthusiasm as confirmed in the questionnaire items. This study can be a reference and encouragement for science teachers to be able to apply home-based experiments in the learning process as a variety of learning methods, especially during the Covid-19 pandemic.

Keywords: home-based experiment, online learning, students' responses

Abstrak

Penelitian ini bertujuan mengungkapkan pandangan dan pendapat siswa terhadap penerapan praktikum dengan home-based experiment *pada materi fotosintesis. Sampel penelitian terdiri dari 1 kelas yang mengimplementasikan pembelajaran dengan* home-based experiment*, dengan jumlah siswa yang terlibat adalah 26 siswa, yang ditentukan secara* convenience sampling technique*. Pengukuran respon siswa menggunakan skala Guttman dimana menuntut jawaban pasti dari siswa pada pernyataan yang diberikan. Siswa diberikan pilihan jawaban "ya" atau "tidak". Kuesioner respon siswa terdiri dari 3 aspek, yaitu sikap siswa terhadap pembelajaran dengan home-based experiment, minat siswa terhadap pembelajaran dengan* home-based experiment*, dan pemahaman siswa terhadap materi pembelajaran setelah penerapan* home-based experiment*. Berdasarkan pada laporan praktikum siswa terkait dengan keberhasilan melaksanakan praktikum yang dibuktikan dengan gambar hasil pengamatan, maka penerapan* home-based experiment *dengan melaksanakan praktikum percobaan Sach menunjukkan hasil yang memuaskan dimana pada umumnya siswa menyelesaikan kegiatan eksperimen dengan baik. Kemudian, penerapan* home-based experiment *mendapatkan respon positif dari siswa dimana dapat mendorong peningkatan kemampuan kerjasama siswa, kemampuan mandiri siswa, dan antusiasme siswa sebagaimana telah dikonfirmasi pada item kuesioner. Penelitian ini dapat menjadi acuan dan dorongan bagi guru IPA untuk bisa menerapkan* home-based experiment *dalam proses pembelajaran sebagai salah satu variasi metode belajar terutama di masa pandemi Covid-19.*

Kata kunci*: home-based experiment, pembelajaran* online*, respon siswa*

Introduction

Education purposes to create better individuals in skill, attitude, knowledge and behavior (Putra et al., 2021). Science learning has a very important role to create and produce good human resources. Science learning serves individuals to be able to learn about themselves and nature so that they can make decisions related to their own lives (Eady, 2008). The nature of science has three components including processes, attitudes, and products. However, the fact is sometimes not as expected that science learning tries to transfer knowledge only (Putra & Agusnita, 2021). Meanwhile, the achievements obtained by students in the science learning process should be following the nature of science, so that the learning result can be maximally achieved. Teachers should have innovations to develop learning activities that are following the needs of the 21st Century (Astika et al., 2022).

Natural Science is knowledge related to the process of finding out everything related to nature which is done systematically and not only knowing about facts, theories, or principles of science but also related to discoveries. Lack of understanding related to science is due to the application of improper methods by teachers. Learning carried out by teachers in the classroom is supposed to be active learning where students not only focus on receiving knowledge from the teacher but also seek knowledge in their own hands with the guidance of the teacher (Gleason et al., 2011). Many learning methods can make students active in the learning process including experimental methods, discussion methods, and demonstration methods.

The experimental method is one of the most appropriate methods used in the science learning process because science is identical to the implementation of experiments (Senisum, 2021). Learning design with experimentation is a method of presenting lessons where students seek their knowledge by demanding student innovation in solving their problems (Etkina et al., 2010). Meanwhile, Kolodner (2002) stated that the experimental method was a learning process where students conduct experiments, observe the experimental process and record the results, prove ideas with the results of experiments, and discuss the results in class with others. Thus, experimentation is an activity of students conducting experiments independently.

Rismawati et al. (2016) explained that the characteristics of experimental methods in learning were: 1) methods to teach students by conducting experiments, doing observations and drawing conclusions on something that is being tested; 2) methods designed to develop students' knowledge; 3) methods that help students in active information processing, so that assisting them in learning to adjust to their environment; 4) methods that lead students to study the learning environment as an ecosystem; 5) methods used to solve problems of a scientific nature. So experimentation is a step carried out in the learning process that combines theoretical and also empirical testing to train students to think rationally and scientifically. Cai et al. (2013) stated that most students expressed satisfaction with the implementation of inquiry learning including experimental methods. Supasorn & Lordkam (2014) stated that the application of the inquiry method in experiments was able to improve the achievement of learning outcomes. Some of the advantages of the experimental method in learning are: 1) the facts or data obtained from the experiment are easy to remember; 2) students work in groups so it trains student cooperation skills; 3) the teacher can directly assess the attitudes and psychomotor of students when carrying out experiments in the laboratory. Devi (2010) stated that carrying out this experimental activity did not always use difficult and complicated research.

The complex concepts in science learning which consist of biology, physics, and chemistry are very demanding for the implementation of learning activities that can make it easier for students to learn and understand these concepts. According to Ardiansyah & Mu'aminah (2020), several things are inseparable from the science learning process, namely the implementation of practicum and theoretical learning. Meanwhile, Nisa (2017) explained that there were at least four reasons related to how important the implementation of practicum activities in science learning is, namely 1)

the implementation of science practicum will be able to arouse student learning motivation; 2) practicum activities can develop basic skills in conducting experiments; 3) practicum activities will be a means of scientific process learning; 4) the implementation of the practicum will support the mastery of the subject matter. Therefore, in the current pandemic situation, it does not mean that science learning eliminates experiments, but experimental activities can be simplified by implementing experiments at home. The Covid-19 pandemic has indeed affected the lives of people from every sector of life. Educational activities have changed from the implementation of the learning process in the classroom to the learning process carried out online (Gurukkal, 2020; Syauqi et al., 2020). Most teachers carry out online learning only by assigning assignments.

The learning activities that are only focused on assignments are certainly not very suitable for science learning. Therefore, during the online learning process, teachers are also required to be able to find solutions for practicum and experimental activities. Adnan & Anwar (2020) stated that during online learning, most students were difficult to learn even students of the university. Therefore, the online learning method that can be applied to improve student activity and understanding of science learning is a home-based experiment. Yuniastuti (2021) stated that a home-based experiment was a practicum carried out by students at home and was a challenge for teachers to reduce laboratory standards to home standards.

Some of the characteristics of a home-based experiment that make it different from laboratory experiments as explained by Zulirfan et al. (2018) were: 1) the equipment in the experiment at home is designed simply and flexibly so that it makes it easier to carry tools from school to home; 2) the modules and learning guides is given to guide students to carry out experimental activities at home; 3) Learning strategies are carried out by involving scientific inquiry activities which begin with preliminary investigations at home, experiments at home, and discussion of the results of investigations at school. In the pandemic condition, experiment activities at home are an option but without activities at school.

One of the materials that can be taught by the practicum method is photosynthesis material. The importance of applying practicum to photosynthetic material because photosynthesis material is one of the materials that often occurs misconceptions in students (Hasanti & Zulyusri, 2022). The importance of applying practicum on photosynthetic material are because the lecture method does not support students' understanding of the material and still many students who still have difficulty understanding the concept of photosynthesis (Sari et al., 2023; Zuhriyah et al., 2019). So, in science learning, photosynthesis material requires practicum to increase students' understanding of learning. Noor et al. (2020) stated that related to the implementation of practicum in online learning by teachers, it was obtained as much as 45% rarely, 35% very rarely and 14% teachers never. Teaching methods or models in science learning should support students to play an active role in learning and can improve results and performance of learning (Freeman et al., 2014).

The implementation of online learning requires proficiency from teachers to determine methods of learning (Wati, 2021). Online practicum techniques during the pandemic are activities carried out by students in their respective homes or even in groups by considering various things. Practicum at home uses tools and materials that are easily accessible around the students' environment and can also be done with the help of the use of practicum simulation videos. Teachers must be able to find alternative materials used in practicum activities so that their activities can still be carried out by considering the use of objects around the house (Darmayanti et al., 2021). However, in pandemic conditions, the implementation of an independent practicum at home is an option that must be done by teachers, especially in science learning. However, in most students, the application of practicum at home is something new. In science learning, practicum is usually carried out inside in schools under observation of teachers. Meanwhile, during the pandemic, the practicum in science

learning must be adjusted to be carried out at home. Because most students do not have experience in implementing home-based experiments, researchers are interested in observing students' responses to home-based experiments. Therefore, this study aimed to reveal students' responses to the implementation of independent practicum at home with home-based experiments on photosynthesis materials. This study can be a reference and encouragement for science teachers to be able to apply home-based experiments in the learning process as a variety of learning methods, especially during the Covid-19 pandemic.

Methods

The research sample was grade 7J students of SMPN 6 Garut. The sample involved in the study was 26 students which were divided into 7 groups. The sampling selection technique used a convenience sampling technique. The implementation of the home-based experiment learning in the sampling class may be the first time because most practicums were conducted in school. Therefore, researchers wanted to ask students' opinions regarding the implementation of the home-based experiment method in the learning process. Students were given a questionnaire regarding the application of learning. The instrument was validated by experts who are lecturers of university. The student response measurement scale used the Guttman scale, which demanded an unequivocal answer from the student to the given question. Students were given a "yes" or "no" answer choice with a score of 1 for the answer "yes" and a score of 0 for the answer "no".

Students' responses to the implementation of the learning process will be an indicator of the successful implementation of the learning process. The student response questionnaire consisted of 3 aspects, namely student attitudes toward home-based experiment learning, student interest in home-based experiment learning, and student understanding of learning materials after home-based experiment learning. The data of student responses were processed using percentages with the following formula,

$$\% \text{ responses} = \frac{\text{Obtained Score}}{\text{Maximal Score}} \text{ x } 100\%$$

Then, the interpretation of the value of students' responses to the learning process can use the following categories (Table 1),

Table 1. Category of Students' Responses

Score Range (%)	Category
0 – 20	Very Low
21 – 40	Low
41 – 60	Enough
61 – 80	Good
81 – 100	Very Good

(Source: Arikunto, 2013)

Topic of practicum was photosynthesis by doing Sach experiment. Photosynthesis material was studied in the seventh grade in the first semester. Basic Competencies (Kompetensi Dasar/KD) for photosynthetic material are KD 3.5 and KD 4.5. Based on the description of Basic Competencies (KD), the abilities that students need to achieve KD of photosynthesis material are not only limited to cognitive abilities but also skill abilities through the implementation of practicum. Related to biology materials, one of the activities that teachers can choose to provide a memorable learning experience for students is through experimental activities and direct observation of phenomena that they can find in daily life.

Result and Discussion

In the implementation of home-based experiments, students were required to collect information independently from various sources with the use of various applications, websites, and simulations to support the learning process. Students were required to report the worksheet according to the findings, but when the findings were wrong, it did not mean that students must also understand the wrong concepts. That's why during the practicum activity, the teacher directs students to look for various sources as a comparison to their findings. Meanwhile, in ordinary practicum, teachers fully supervise the implementation of the practicum so that misconceptions can be minimized. However, in this implementation of home-based experiments showed satisfactory results where most students

completed the process well. Figure 1, Figure 2 and Figure 3 showed some experimental results from several groups.

Figure 1. Practicum result of group 2

Figure 2. Practicum result of group 4

Figure 3. Practicum result of group 6

Figure 1 and Figure 2 show examples of the success of the practicum result of groups. Meanwhile, Figure 3 shows an example of the failure of the practicum result of group. Among 7 groups of students, only 1 group failed to complete the experiment well. Based on the teacher's analysis, this failure was mainly due to a procedure error, namely the use of thick leaves. Of course, this is a great achievement where the implementation of the independent practicum shows a successful practicum result for almost the entire group. The indicator of successful practicum is the success of students to complete the practicum well and to report the practicum result well (See Figure 1, Figure 2, and Figure 3).

The success of the learning process depends on the successful application of the learning method or model. The successful use of the applied method or model can be seen in the student's response to the learning process. As Takdir (2017) stated that the opportunity given to students to respond the learning method was to measure the success of the applied method. In this study, researchers observed students' perceptions and responses to the implementation of home-based experiment learning. The questionnaire of student responses to the learning process consists of several aspects, namely students' interest in home-based experiment learning, students' understanding of learning materials after the application of home-based experiments, and students' attitudes toward home-based experiment learning. Each of the observed aspects consists of several representative statements. The percentage of student responses to each aspect can be seen in the Table 2.

Table 2. Percentage of Students' Response

No	Statements	Percentage	Criteria
1	Students' attitudes toward home-based experiment learning	80.7%	Very Good
2	Students' interest in home-based experiment learning	88.5%	Very Good
3	Students' understanding of learning materials after the implementation of home-based experiments	76.9%	Good

The implementation of a home-based experiment may be new for some students because it has never been implemented before. So, it is necessary to know how students respond after the implementation of home-based experiments. By distributing questionnaires to students to find out student responses, some important information was obtained related to student responses in the home-based experiment learning process. Students' responses to the aspect of students' attitudes toward home-based experiment

learning showed positive results. The percentage value is 80.7% and is categorized as very good. This high score confirms that most students agreed that home-based experiment learning helped them understand the biological material studied and the application of home-based experiments was appropriate for photosynthesis topic learning. Furthermore, the positive result on the aspect of students' attitudes toward home-based experiment learning also shows that most students agreed that home-based experiments improved cooperation abilities, and improved their independent ability to build knowledge. Finally, the positive result in the aspect of students' attitudes toward home-based experiment learning also shows that students had a high willingness to learn by finding problem solutions. Therefore, in general, students show a positive attitude toward home-based experiment learning. Sundari et al. (2017) stated that students gave positive responses to practicum-based learning.

In the aspect of students' interest in home-based experiment learning, information was obtained that students showed a very good interest in home-based experiment learning where the percentage is 88.5%. The positive result in this aspect shows that students had high enthusiasm for participating in home-based experiment learning. This result is in line with the research of Prasetyo et al. (2022) that the implementation of practicum can increase students' interest in learning. Then, the aspect of students' understanding of learning materials after the implementation of home-based experiments also shows a positive result. So, most students stated that home-based experiment method helped them to understand the concept well. This finding is only based on students' response and opinion by using questionnaire. To know more about students' understanding of learning materials, it is needed to test students by using questions.

Then, in this study, compared to the attitude and interest aspects, the percentage in the aspect of students' understanding of learning materials after the application of home-based experiments is the lowest. The positive percentage on the aspects of students' understanding of the learning material after the implementation of the home-based experiment also confirms that most students agreed that the implementation of home-based experiments supported them to a better understanding of the photosynthesis material. Most students also stated that home-based experiments were good for supporting students' understanding of biology learning, especially during a pandemic. Nisa (2017) stated that the practicum method can improve students' understanding of learning. So it is concluded that the implementation of home-based experiments is one of the learning methods that are suitable to be applied by teachers in biology learning. Home-based experiments can become an alternative in practicum activities during a pandemic. Then, not all biology materials are suitable for the implementation of home-based experiments, teachers must also be able to measure the possibility of learning topics by implementing home-based experiments, especially during online learning.

The positive statements given by students in their response to the implementation of home-based experiments can be used as a reason why it is important to carry out practicum in science learning. The cooperation ability of students, the independent ability of students, and student enthusiasm will certainly be able to be developed with home-based experiment learning. The implementation of home-based experiments in this study strongly supported students to carry out scientific methods where students were directed to carry out problem formulation activities, make hypotheses, collect data, test hypotheses, and formulate conclusions. The fundamental difference between home-based experiments and ordinary practicum is that home-based experiments are more likely to be implemented independently (Zulirfan et al., 2018) by students in groups. Meanwhile, in an ordinary practicum in the laboratory, as commonly implemented, students are guided by full teacher supervision so that they can complete practicum activities properly (Permana, 2022). In ordinary practicum when students face obstacles in a practicum they can freely ask the teacher. Meanwhile, in a home-based experiment, students are

more required to be able to independently solve the problems by looking for various reference sources through the use of various applications, websites, and simulations to support the learning process rather than asking teachers (Ministry of Education Malaysia, 2021). However, each of them has advantages and disadvantages. Perhaps in the future, teachers should familiarize students with carrying out independent learning such as home-based experiments so that students become proficient and accustomed to working independently.

Conclusion

The implementation of home-based experiments in Sach experiment showed satisfactory results where most students completed the process well. The implementation of the home-based experiment got a positive response from students. The positive statements given by students can be used as a reason why it is important to carry out practicum in science learning. The cooperation ability of students, the independent ability of students, and student enthusiasm will certainly be able to be developed with home-based experiment learning. Therefore, the learning process with home-based experiments can be an option to be applied in the online learning process or as a variation of the learning process. Perhaps in the future, teachers should familiarize students with carrying out independent learning such as home-based experiments so that students become proficient and accustomed to working independently. This study can be a reference and encouragement for science teachers to be able to apply home-based experiments in the learning process as a variety of learning methods, especially during online learning.

References

Adnan, M., & Anwar, K. (2020). Online Learning amid the COVID-19 Pandemic: Students' Perspectives. *Journal of Pedagogical Sociology and Psychology*, *2*(1), 45-51.

Ardiansyah, A., & Mu'aminah (2020). Analisis Sikap Ilmiah Peserta Didik pada Praktikum Mandiri Berbasis Proyek pada Materi Optik SMPN 4 Sojol di Masa Pandemi. *Koordinat Jurnal MIPA*, *1*(2), 31-38.

Arikunto, S. (2013). Prosedur Penelitian Suatu Pendekatan Praktek. Edisi Revisi. Jakarta: Rineka Cipta.

Astika, E., Surtikanti, H. K., Kusnadi, K., & Putra, N. S. (2022). Profile of Students' Science Process Skills on Conventional Biotechnology Material. *Journal of Science Education Research*, *6*(2), 91-97. http://dx.doi.org/10.21831/jser.v6i2.51083

Cai, S., Chiang, F. K., & Wang, X. (2013). Using the Augmented Reality 3D Technique for a Convex Imaging Experiment in a Physics Course. *International Journal of Engineering Education*, *29*(4), 856-865.

Darmayanti, N. W. S., Wijaya, I. W. B., & Haifaturrahmah, H. (2021). Analisis Motivasi Belajar Siswa SD Bidang Studi IPA di Tengah Pandemi Covid-19 melalui Praktikum Berorientasikan Lingkungan Sekitar Rumah. *Jurnal Elementary: Kajian Teori dan Hasil Penelitian Pendidikan Sekolah Dasar*, *4*(2), 139-143. https://doi.org/10.31764/elementary.v4i2.5217

Devi, P. K. (2010). Metode-metode dalam pembelajaran IPA. Bandung: Pusat Pengembangan dan Pemberdayaan Pendidik dan Tenaga Kependidikan IPA.

Eady, S. (2008). What is the Purpose of Learning Science? An Analysis of Policy and Practice in the Primary School. *British Journal of Educational Studies*, *56*(1), 4-19. https://doi.org/10.1111/j.1467-8527.2007.00391.x

Etkina, E., Karelina, A., Ruibal-Villasenor, M., Rosengrant, D., Jordan, R., & Hmelo-Silver, C. E. (2010). Design and Reflection Help Students Develop Scientific Abilities: Learning in Introductory Physics Laboratories. *The Journal of the Learning Sciences*, *19*(1), 54-98. https://doi.org/10.1080/10508400903452876

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active Learning Increases Student Performance in Science, Engineering, and Mathematics. *Proceedings of the National Academy of Sciences of the United States of America, 111*(23), 8410–8415.

Gleason, B. L., Peeters, M. J., Resman-Targoff, B. H., Karr, S., McBane, S., Kelley, K., Thomas, T., & Denetclaw, T. H. (2011). An Active-Learning Strategies Primer for Achieving Ability-Based Educational Outcomes. *American Journal of Pharmaceutical education*, *75*(9). https://doi.org/10.5688/ajpe759186

Gurukkal, R. (2020). Will Covid 19 Turn Higher Education into Another Mode? *Higher Education for the Future*, *7*(2), 89-96. https://doi.org/10.1177/2347631120931606

Hasanti, M. A., & Zulyusri, Z. (2022). Meta-Analisis Miskonsepsi Siswa Mata Pelajaran IPA Materi Biologi Tingkat SMP. PENDIPA Journal of Science Education, 6(1), 263-268. https://doi.org/10.33369/pendipa.6.1.263-268

Ministry of Education Malaysia. (2021). Home-Based Experiment Guide. Malaysia: Matriculation Division: Ministry of Education Malaysia

Kolodner, J. L. (2002). Learning by design™: Iterations of Design Challenges for Better Learning Of Science Skills. *Cognitive Studies: Bulletin of the Japanese Cognitive Science Society*, *9*(3), 338-350. https://doi.org/10.11225/jcss.9.338

Nisa, U. M. (2017). Metode Praktikum untuk Meningkatkan Pemahaman dan Hasil Belajar Siswa Kelas V MI YPPI 1945 Babat pada Materi Zat Tunggal dan Campuran. *Proceeding Biology Education Conference: Biology, Science, Enviromental, and Learning*, *15*(10), 62-68.

Noor, Y. A., Putra, N. M. D., Nugroho, S. E., Marwoto, P., Mindyarto, B. N., Linuwih, S., ... & Minhat, M. (2020). Praksis Praktikum Fisika Mode Daring: Studi Kasus Pembelajaran di SMA/MA Jawa Tengah dan Jawa Timur Semasa Pandemi Covid-19. *UPEJ Unnes Physics Education Journal*, *9*(3), 276-283. https://doi.org/10.15294/upej.v9i3.45868

Permana, A. C. (2022). Pemahaman dan Kesadaran Keselamatan Kerja Laboratorium IPA Siswa SMP. *Jurnal Pendidikan Modern*, *7*(3), 87-96. https://doi.org/10.37471/jpm.v7i3.461

Prasetyo, E., Haruna, H., & Mapparenta, S. (2022). Implementasi Pembelajaran Praktikum untuk Meningkatkan Minat Belajar Siswa di SMKN 2 Tanah Grogot. *Jurnal Profesi Kependidikan*, *3*(1), 129-134.

Putra, N. S., & Agusnita (2021). Scientific Literacy Competency of Senior High School Students Based on Question Formats. *Journal of Physics: Conference Series*, *1882*(1), 012161. IOP Publishing.

Putra, N. S., Sukma, H. N., & Setiawan, H. (2021). Level of Environmental Literacy of Students and School Community in Green Open Space: Is There any Difference between Both of Them? *Jurnal Pendidikan IPA Indonesia*, *10*(4), 627-634. https://doi.org/10.15294/jpii.v10i4.31083

Rismawati, R., Ratman, R., & Dewi, A. I. (2016). Penerapan Metode Eksperimen dalam Meningkatkan Pemahaman Konsep Energi Panas pada Siswa Kelas IV SDN No. 1 Balukang 2. *Jurnal Kreatif Online*, *4*(1), 99-215.

Sari, M. S. N., Hermalia, I. A., Sanjoyo, T. B. P., Rachmawati, I. A., Renata, N. K., & Anjarwati, A. (2023). Meningkatkan Sikap Ilmiah Siswa Abad 21 Melalui Kegiatan Eksperimen pada Materi Fotosintesis. *Journal on Education*, *5*(2), 4030-4040. Diakses darihttps://jonedu.org/index.php/joe/article/view/1095

Senisum, M. (2021). Keterampilan Proses Sains Siswa SMA dalam Pembelajaran Biologi. *Jurnal Pendidikan dan Kebudayaan*

Missio, 13(1), 76-89. https://doi.org/10.36928/jpkm.v13i1.661

Sundari, T., Pursitasari, I. D., & Heliawati, L. (2017). Pembelajaran Inkuiri Terbimbing Berbasis Praktikum pada Topik Laju Reaksi. *JPPS (Jurnal Penelitian Pendidikan Sains), 6*(2), 1340-1347. https://doi.org/10.26740/jpps.v6n2.p1340-1347

Supasorn, S., & Lordkam, A. (2014). Enhancement of Grade 7 Students' Learning Achievement of the Matter Separation by Using Inquiry Learning Activities. *Procedia-Social and Behavioral Sciences, 116*, 739-743. https://doi.org/10.1016/j.sbspro.2014.01.290

Syauqi, K., Munadi, S., & Triyono, M. B. (2020). Students' Perceptions toward Vocational Education on Online Learning during the COVID-19 Pandemic. *International Journal of Evaluation and Research in Education, 9*(4), 881-886. http://doi.org/10.11591/ijere.v9i4.20766

Takdir, M. (2017). Kepomath Go "Penerapan Konsep Gamifikasi dalam Pembelajaran Matematika dalam Meningkatkan Motivasi Belajar Matematika Siswa". *Penelitian Pendidikan INSANI, 20*(1), 1-6. https://doi.org/10.26858/ijes.v20i1.4493

Wati, A. (2021). Penggunaan Media Virtual Laboratory untuk Meningkatkan Penguasaan Konsep Materi dan Kemandirian Siswa Melakukan Praktikum. *Jurnal Guru Dikmen dan Diksus, 4*(2), 256-270. https://doi.org/10.47239/jgdd.v4i2.373

Yuniastuti, N. (2021). Peningkatan Motivasi dan Hasil Belajar Daring Biologi melalui Home Based Experiment Model Inquiry Based Learning. *Ideguru: Jurnal Karya Ilmiah Guru, 6*(1), 92-100.

Zuhriyah, M., Yuliani, Y., & Dewi, S. (2019). Kelayakan Lkpd Berbasis Learning Cycle 7E Materi Fotosintesis Dan Respirasi untuk Melatihkan Kemampuan Berargumentasi Ilmiah. *BioEdu, 8*(2), 218-224.

Zulirfan, I., Osman, K., & Salehudin, S. N. M. (2018). Take-Home-Experiment: Enhancing Students' Scientific Attitude. *Journal of Baltic Science Education, 17*(5), 828.