

Biology practical activity during pandemic: Study on obstacles and teachers' strategies in overcoming it

Ramadhayanti ⁽¹⁾, Bambang Supriatno ⁽²⁾, Eni Nuraeni ^{(2)*}

⁽¹⁾ Master Program of Biology Education, School of Postgraduates, Universitas Pendidikan Indonesia, Bandung City, West Java, Indonesia

⁽²⁾ Study Program of Biology Education, Faculty of Mathematics and Science Education, Universitas Pendidikan Indonesia, Bandung City, West Java, Indonesia

*Corresponding Author Email: eninuraeni@upi.edu

Article Information	Abstract
<p>Keyword: Biology practical activity; Distance learning; COVID-19 pandemic</p> <p>Kata Kunci: Kegiatan praktikum biologi; Pembelajaran jarak jauh; Pandemi COVID-19</p>	<p>Practical activity is an integral part of science learning process, including biology. However, during distance learning in the era of COVID-19 pandemic, biology practical activities are often not carried out due to a number of obstacles. This study aims to explain the various obstacles or problems experienced by teachers when conducting biology practical activities during the COVID-19 pandemic. The data of this study were collected by distributing questionnaires to 54 teachers who teach natural sciences in Junior High Schools and biology in Senior High Schools in West Java Province with different lengths of teaching experience. The results showed that the teachers experienced several problems, such as limited allocation of learning time during distance learning, the difficulty of designing practical activities that could be carried out independently by students at home, and the difficulty of finding alternative tools and materials at students' homes. To overcome these obstacles, the teachers has made various efforts and the most chosen were asking students to watch videos of practical activities or simplifying the practical activities so that they can be carried out independently by students at home.</p>
<p>History: Received : 30/12/2021 Accepted : 11/02/2022</p>	<p>Abstrak</p> <p>Kegiatan praktikum adalah bagian tak terpisahkan dari proses pembelajaran sains, termasuk biologi. Namun selama Pembelajaran Jarak Jauh (PJJ) di era pandemi COVID-19, kegiatan praktikum biologi seringkali tidak dilaksanakan karena adanya sejumlah kendala. Penelitian ini bertujuan untuk mengungkap berbagai kendala atau permasalahan yang dialami oleh para guru saat melaksanakan kegiatan praktikum biologi selama pandemi COVID-19. Pengumpulan data penelitian dilakukan dengan membagikan kuesioner kepada 54 orang guru yang mengajar IPA Terpadu di SMP dan biologi di SMA di Provinsi Jawa Barat dengan lama pengalaman mengajar yang berbeda-beda. Hasil penelitian menunjukkan bahwa para guru mengalami kendala berupa keterbatasan alokasi waktu pembelajaran yang tersedia selama PJJ, sulitnya merancang kegiatan praktikum yang dapat dikerjakan secara mandiri oleh peserta didik di rumah, dan sulitnya menemukan alat dan bahan praktikum alternatif yang mudah ditemukan di lingkungan sekitar rumah peserta didik. Untuk mengatasi kendala-kendala tersebut, para guru telah melakukan beragam upaya dan upaya yang paling sering dilakukan adalah meminta peserta didik untuk menonton video kegiatan praktikum dan menyederhanakan kegiatan praktikum agar dapat dilaksanakan secara individu di rumah masing-masing peserta didik.</p>

A. Introduction

Science or natural science has two important approaches, including science as a product and science as a process. Science as a product is a collection of knowledge in the form of facts, concepts, principles, theories, and laws, while science as a process is a way to get that collection of knowledge, one of which is through observation. According to the constructivism theory proposed by Piaget, a person can build his own knowledge through assimilation and accommodation that takes place in his cognitive structure according to the initial knowledge he has. In relation to this theory, Millar (2004) argued that observation is something that is very essential as the initial process of knowledge formation and becomes an important part of a practical activity.

Practical activity is one of the alternative choices that teachers can choose to help students achieve their learning goals (Millar & Abrahams, 2009). According to Millar & Abrahams (2009), practical activities have several objectives which can be classified into three main objectives. First, practical activities can help students to develop their knowledge of the nature of the world and their understanding of scientific concepts and theories. Second, practical activities can help students learn to use practical equipments and follow various scientific procedures. Third, practical activities can help students to develop their understanding of scientific inquiry.

Practical activities can provide opportunities for students to prove themselves the concepts and theories they have learned in class, develop data analysis skills, and various other skills (UK Center for Bioscience, 2010). Specifically in biology, the Society of Biology (2010) argued that it is important to support and improve the quality of biology practical activities because they are able to provide an overview of the beauty and complexity of living systems, as well as an understanding of how to obtain information from these living systems. In addition, practical activities are also able to provide experience for students to learn to analyze and evaluate various research variables, increase discussions on ethical issues, and provide them with skills to face global challenges in the future.

Various scientific studies have shown the benefits of practical activities in science education. A prior research conducted by Koirala (2019) on students in secondary schools in Nepal found that practical activities are effective for teaching science because they can help the students to understand scientific concepts better. The result of this research is in accordance with a previous research

conducted by Festile (2017) which revealed that students experienced an increased understanding of the scientific concepts they were studying after carrying out practical activities. In addition, there was also an increase in the ability of students to use various practical equipments and it had a positive impact on their memory of these scientific concepts.

Practical activities are also often considered more fun by students than other learning methods for learning science. However, during distance learning in the era of COVID-19 pandemic, practical activities are increasingly experiencing problems due to a number of obstacles. In this study, specifically we want to explore the reasons behind obstacles in designing practical activity and what the teachers have done to overcome it. Based on the descriptions above, in this article the research questions are (1) what obstacles are experienced by teachers in conducting practical activities as part of the biology learning process during distance learning or learning from home?, and (2) what solutions can be used by teachers to overcome these obstacles?

B. Material and Method

This type of research is descriptive research with a quantitative approach because it aims to reveal various obstacles or problems experienced by teachers when conducting biology practical activities during the COVID-19 pandemic. The research data were collected by distributing questionnaires to 54 teachers: 49 teachers teach natural sciences in Junior High Schools and 5 teachers teach biology in Senior High Schools in West Java Province with different lengths of teaching experience (Table 1). The questionnaire contained a number of closed-ended and open-ended questions to obtain a complete picture of the obstacles experienced by the teachers and analyzed the causes. The questions asked were regarding the preferences of the teachers to conduct practical activities during distance learning, the frequency of practical activities, the obstacles experienced when designing practical activities, what basic competencies were chosen to be taught with these practical activities, and the efforts they have made to still conduct or optimize practical activities during the pandemic.

In addition, the researchers also conducted a literature study on the Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 35 of 2018 on the 2013 Junior High School/ Madrasah Tsanawiyah Curriculum, Regulation of the Minister of Education and Culture

of the Republic of Indonesia Number 36 of 2018 on the 2013 High School/Madrasah Aliyah Curriculum, and Decree of the Minister of Education and Culture of the Republic of Indonesia Number 719/P/2020 on Guidelines for Curriculum Implementation in Education Units in Special Conditions. This study was conducted to understand the rules and role of the government in regulating the learning process, especially during the pandemic. The data obtained were then analyzed using descriptive statistics and displayed in the form of percentages (%).

Table 1 Length of Teaching Experience of Research Participants

Length of Teaching Experience (Year)	Number of Teachers
0 - 5	19
6 - 10	5
11 - 15	10
16 - 20	8
21 - 25	4
26 - 30	7
>30	1
Total	54

C. Results and Discussion

The COVID-19 pandemic that has lasted for almost two years has brought many changes to the pattern of education. The learning process that originally took place face-to-face in schools turned into online learning using technology. This change does not necessarily run well and has an impact on how teachers teach science in schools, especially biology. Biology learning, which is identical to practical activities, is now experiencing challenges and obstacles in its implementation due to a number of obstacles in online learning.

Preferences of Teachers to Conduct Practical Activities During Distance Learning

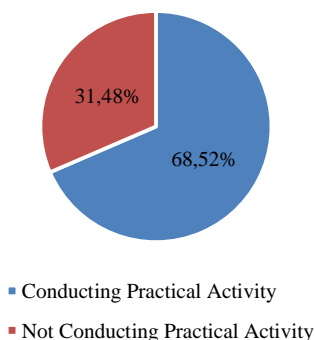


Figure 1 Preferences of Teachers to Conduct Practical Activities During Distance Learning

These obstacles are generally in the form of lack of facilities that are able to support the online

biology learning process during pandemic (Anjarwati et al., 2021). In addition, access to the internet services and the high cost of internet quotas are also obstacles in the online learning process (Sadikin & Hamidah, 2020; Sholichin et al., 2021). However, during distance learning more than half of the participants (68.52%) in this research consisting of natural sciences and biology teachers still chose to conduct practical activities as part of the learning process during pandemic (Figure 1).

However, according to the data shown in Figure 2, most of these teachers only conducted practical activities once per semester for one basic competency. In junior high schools, most of the teachers preferred to conduct practical activities when teaching biology and the most frequently chosen topics were environmental pollution, biotechnology, and living things and their environment. Meanwhile, in senior high schools, the most frequently chosen topics were plantae and metabolism.

Frequency of Practical Activities During Distance Learning

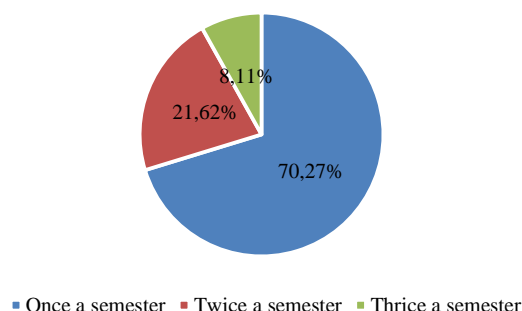


Figure 2 Frequency of Practical Activities During Distance Learning

The physics topics that were most often chosen to be taught through practical activities in natural sciences in junior high schools were pressure of substances and natural objects and observation. In addition, there were also some teachers who chose chemistry topics such as acid-base indicator experiment and additives and addictive substances as a topic for students practical activities. Details of the topics and sub-topics for practical activities and the number of teachers who choose those topics are presented in Table 2 dan Table 3.

There are some reasons why the topics were chosen by the teachers instead of others. The topics can be learned by field experiments or observations, not by experiments in a laboratory that require special tools, materials, space, and time allocation. It can be carried out independently

by students at home with simple tools and materials that can be found more easily, low cost, and without long and complicated procedures. Still some practical activities are carried out by experiments in a virtual laboratory such as nutrition and food tests and acid-base indicator experiment in Rumah Belajar learning portal. When referring to the curriculum especially for the

biology basic competencies for those topics, they have not undergone any changes or simplifications in emergency curriculum, but plantae. It should be learned as part of principles of classification of living things basic competency so that the teachers still choose to carry out practical activities for this and the other four topics.

Table 2 Topics for Practical Activities Chosen by Natural Sciences Teachers in Junior High Schools During Distance Learning

No.	Topics for Practical Activities	Number of Teachers
Biology Topics in Natural Sciences in Junior High Schools		
1.	Classification of Living Things	2
2.	Levels of Organization	1
3.	Living Things and Their Environment: Ecosystems and Interaction of Living Things	4
4.	Environmental Pollution: Water Pollution, Soil Pollution, and Air Pollution	5
5.	Movement of Living Organisms	1
6.	Structure and Function of Plant Tissues: Transportation in Plants	1
7.	Digestive System: Nutrition and Food Tests	2
8.	Respiratory System	1
9.	Reproduction in Plants and Animals	2
10.	Heredity	1
11.	Biotechnology: Conventional Biotechnology	5
Physics Topics in Natural Sciences in Junior High Schools		
1.	Natural Objects and Observation: Measurement	3
2.	Phase Transitions: Classification of Matter	1
3.	Temperature and Its Changes	2
4.	Heat and Its Movements	1
5.	Movement of Non-Living Things	2
6.	Pressure of Substances	5
7.	Vibration and Wave	1
8.	Magnetism	2
9.	Dynamic Electricity: Electricity Circuit	1
Chemistry Topics in Natural Sciences in Junior High Schools		
1.	Acid-base Indicator Experiment	2
2.	Additive and Addictive Substances	2

Table 3 Topics for Practical Activities Chosen by Biology Teachers in Senior High Schools During Distance Learning

No.	Topics for Practical Activities	Number of Teachers
1.	Fungi	1
2.	Plantae	2
3.	Digestive System	2
4.	Respiratory System	1
5.	Growth and Development	1
6.	Metabolism: Photosynthesis	2

Nevertheless, according to the interview with some teachers, most of them provided a verification practical activity not an inquiry. They explained the concepts related to the topics first, gave each student a worksheet or an example as the guideline, and then the students carried out the practical activity independently at home. For example, the teachers asked students to make a

conventional biotechnology product such as tempe and yoghurt with no manipulation of independent variable. Meanwhile the virtual experiments will not give the students a full sensory experience and how to deal with unexpected condition and results in real life.

The low frequency of practical activities during distance learning is also influenced by a number of obstacles experienced by the teachers (Figure 3). In general, the more obstacles teachers experience, the frequency of practical activities conducted will also decrease. A total of 70.59% of teachers who did not conduct any practical activities experienced the main obstacle specifically the limited allocation of learning time during distance learning. Prior to the pandemic, according to the Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 35 of 2018 on the 2013 Curriculum for Junior High Schools/Madrasah Tsanawiyah (2018), the time

allocation for natural sciences is five hour lesson per week for class VII, VIII, and IX.

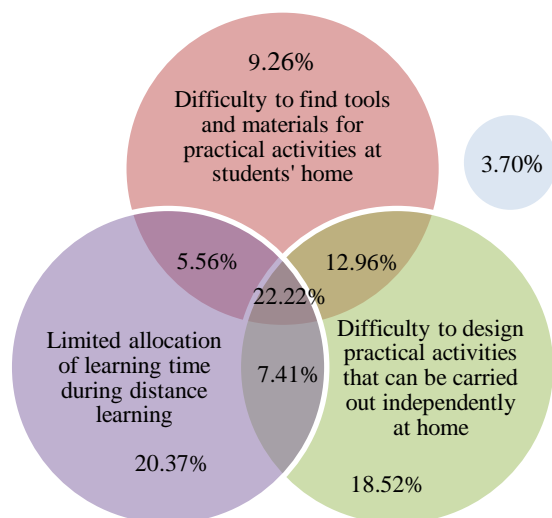


Figure 3 Obstacles to Practical Activities During Distance Learning

Meanwhile, according to the Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 36 of 2018 on the 2013 Curriculum for Senior High Schools/Madrasah Aliyah (2018), biology is an academic specialization subject with three hour lesson per week for class X and four hour lesson per week for class XI and XII. But, during this distance learning the number of days and hour lesson had a significant reduction to only one hour lesson per week and this policy can be determined by each educational unit according to the situation and needs.

In order to overcome these obstacles, the government has issued Decree of the Minister of Education and Culture of the Republic of Indonesia Number 719/P/2020 on Guidelines for Curriculum Implementation in Education Units in Special Conditions (2020) to enforce an emergency curriculum that focuses on essential competencies and prerequisite competencies for continued learning in next level. However, the basic competencies for natural sciences and biology in this curriculum have not experienced much simplification from the 2013 Curriculum, so they cannot adapt to the limited allocation of learning time. In natural sciences, there is a simplification of basic competencies without reducing their numbers. In knowledge competencies, simplification is done by eliminating some topics and lowering the level of competencies. In skills competencies, simplification is done by changing the assessment method, for example from initially conducting an investigation to presenting the results of searching for information or from making

a real work to just making a design. As for biology, there is a reduction in the number of basic competencies with details of reducing 5 basic competencies in class X, 2 basic competencies in class XI, and 1 basic competence in class XII without any simplification of those basic competencies maintained. However, for class XII, there is a simplification in only 1 basic competency by reducing the details of the sentence editorial. Although the government has provided flexibility for schools to choose a curriculum that suits the learning needs of students, these teachers in fact still have difficulties simplifying these basic competencies independently.

Another obstacle that was also experienced by most of the teachers was the difficulty to design a practical activity that could be carried out independently by students at home. The teachers who have tried to simplify practical activities also experienced this problem. The emergence of this obstacle is related to the difficulty of teachers to find alternative tools and materials available at students' home that can be used as objects of observation and to bring up phenomena that can be observed. The quality of alternative tools and materials chosen will also certainly have an impact on the quality of observation, even the quality of the objects and phenomenas of student worksheets in student textbooks varies greatly (Ramadhayanti, Soesilawaty, et al., 2020). However this problem can be solved by reconstructing the conceptual, procedural, and knowledge construction aspects of a practical activity (Ramadhayanti et al., 2020). Obstacles in designing a practical activity were experienced by both new teachers and those who have more than 20 years of teaching experience. Therefore, to overcome the obstacles experienced, the teachers have also made various other efforts that they thought relevant and easy to do by students with all the limitations of the existing online learning process.

The most chosen efforts by teachers were asking students to watch videos of practical activities or simplifying the activities so that they could be carried out independently by students at home. Half of the teachers who chose a combination of these two efforts asked students to act like the practical activities in the video, recorded it in a video, and submitted it via Whatsapp or Google Form. The teachers who did not conduct any practical activities at all, almost all of them only asked students to watch the videos of the practical activities they had given. The same thing was also stated by previous research conducted by Handayani & Jumadi (2021) and Kurniati et al., (2021) which stated that most of the

natural sciences and biology teachers did not conduct practical activities during the pandemic. If a basic competency demands the implementation of practical activities, the teachers only asked students to watch experimental videos on Youtube or assigned students to carry out practical activities independently by using tools and materials available at their homes. However, there were also few teachers who have tried to use virtual experiments freely available on the internet as a substitute for real practical activities and carry out collaborative practical activities with other subjects.

Whatever way a teacher choose to plan a practical activity, it should be pointed to the learning objectives. Using a practical activity is a choice, but a clear learning objective can lead to an effective and more demanding task (Millar & Abrahams, 2009). A simple practical activity task only leads students to observe and remember it, but a higher demanding task would help students to think critically about scientific concepts and make sense about what they observed. Although the practical activities are carried out only once per semester and using simple tools and materials, nevertheless the student worksheets used commonly as a guideline for practical activity should help students to train their quantitative literacy and 4Cs of the 21st century skills, which are communication, collaboration, critical thinking, and creativity in order to support their life in today's world. Association of American Colleges & Universities (2009) defines quantitative literacy as a habit of mind that demonstrates the ability to interpret and analyze various forms of quantitative data presentation, such as tables, graphs, mathematical equations, and other relevant forms. Quantitative literacy is important because this ability can increase students' opportunities to obtain better education and jobs, compete globally and face job demands, and participate in society (The New Hampshire Department of Education, 2010).

D. Conclusion

During distance learning or learning from home, more than half of the participants consisting of natural sciences and biology teachers chose to conduct practical activities as part of the learning process during the pandemic. However, most of these teachers only conduct practical activities once per semester for one basic competency. The low frequency of practical activities during distance learning is influenced by a number of obstacles experienced by the teachers, such as limited allocation of learning time during distance learning,

the difficulty of designing practical activities that can be carried out independently by students at home, and the difficulty of finding alternative tools and materials at students' homes. The most chosen efforts by teachers were asking students to watch videos of practical activities or simplifying the activities so that they could be carried out independently by students at home.

E. References

- Anjarwati, S., Wardany, K., Khoirudin, M., & Novitasari, C. (2021). Analisis kendala dan alternatif pembelajaran biologi pada masa pandemi COVID-19 di SMA Muhammadiyah 1 Bangunrejo. *Oryza Jurnal Pendidikan Biologi*, 10(2), 10-18.
- Association of American Colleges & Universities. (2009). *Quantitative literacy value rubric*. <https://www.aacu.org/value/rubrics/quantitative-literacy>
- Festile, R. M. (2017). *The influence of practical work in the teaching and learning of acids, bases, and neutrals in natural sciences*. Unpublished master thesis, University of the Western Cape.
- Handayani, N. A., & Jumadi. (2021). Analisis pembelajaran IPA secara daring pada masa pandemi COVID-19. *Jurnal Pendidikan Sains Indonesia*, 9(2), 217-233.
- Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi. (2018). Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 35 Tahun 2018 tentang Perubahan Atas Peraturan Menteri Pendidikan dan Kebudayaan Nomor 58 Tahun 2014 Tentang Kurikulum 2013 Sekolah Menengah Pertama/Madrasah Tsanawiyah. Jakarta: Kementerian Hukum dan Hak Asasi Manusia Republik Indonesia.
- Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi. (2018). Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 36 Tahun 2018 tentang Perubahan Atas Peraturan Menteri Pendidikan dan Kebudayaan Nomor 59 Tahun 2014 Tentang Kurikulum 2013 Sekolah Menengah Atas/Madrasah Aliyah. Jakarta: Kementerian Hukum dan Hak Asasi Manusia Republik Indonesia.
- Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi. (2018). Keputusan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 719/P/2020 tentang Pedoman Pelaksanaan Kurikulum pada Satuan Pendidikan dalam Kondisi Khusus. Jakarta: Kementerian Hukum dan Hak Asasi Manusia Republik Indonesia.
- Koirala, K. P. (2019). Effectiveness of practical work on students' achievement in science at

- secondary level in Gorkha District Nepal. *Journal of Advances in Education Research*, 4(4), 139–147.
- Kurniati, T., Yusup, I. R., Hermawati, A. S., Kusumahwardani, D., Wijayanti, D., & Irhamudzikri. (2021). Respon guru terhadap kendala proses pembelajaran biologi di masa pandemi COVID-19. *Jurnal Educatio FKIP UNMA*, 7(1), 40–46.
- Millar, R. (2004). *The role of practical work in the teaching and learning of science, high school science laboratories: role and vision*. Unpublished paper prepared for the Committee: High School Science Laboratories: Role and Vision, National Academy of Sciences. Washington, DC.
- Millar, R., & Abrahams, I. (2009). Practical work: making it more effective. *School Science Review*, 91(334), 59–64.
- Ramadhayanti, Anggraeni, S., & Supriatno, B. (2020). Analisis dan rekonstruksi lembar kerja peserta didik indra pengecap berbasis diagram vee. *BIODIK: Jurnal Ilmiah Pendidikan Biologi*, 6(2), 95–108.
- Ramadhayanti, Soesilawaty, S. A., & Nuraeni, E. (2020). Analisis kualitas struktur dan keberadaan literasi kuantitatif pada lembar kerja peserta didik biologi SMA. *Assimilation: Indonesian Journal of Biology Education*, 3(1), 25–33.
- Sadikin, A., & Hamidah, A. (2020). Pembelajaran daring di tengah wabah COVID-19. *BIODIK: Jurnal Ilmiah Pendidikan Biologi*, 6(2), 214–224.
- Sholichin, M., Zulyusri, Lufri, & Razak, A. (2021). Analisis kendala pembelajaran online selama pandemi COVID-19 pada mata pelajaran IPA di SMPN 1 Bayung Lencir. *BIODIK: Jurnal Ilmiah Pendidikan Biologi*, 7(2), 163–168.
- Society of Biology. (2010). *The importance of practical biology: from school to higher education*. Unpublished practical biology position statement. London.
- The New Hampshire Department of Education. (2010). *New Hampshire PreK-16 numeracy action plan for the 21st century*. Unpublished Numeracy Action Plan. New Hampshire.
- UK Center for Bioscience. (2010). *Student short guide: making the most of practical work*. Unpublished student short guide. Leeds.