BIO-INOVED
Jurnal Biologi-Inovasi Pendidikan
Volume 5, Issue 3, October 2023 page. 419-427

P-ISSN : 2684-9062 | E-ISSN : 2714-9803
https://ppjp.ulm.ac.id/journal/index.php/bino
DOI: 10.20527/bino.v5i3.16833

Increasing understanding of biology concepts through writing scientific papers during the pandemic

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Article Information

Keyword:
Scientific writing; Online classes; Pandemic; Mastery; Biology concepts

Kata Kunci:
Penulisan ilmiah; Kelas daring; Pandemi; Penguasaan; Konsep biologi

History:
Received : 10/07/2023
Accepted : 23/10/2023

Abstract

Learning activities were carried out online during the Covid-19 pandemic. Students must improve their ability to write biological scientific papers and apply them in the real world, even presenting them during distance learning. This research is classroom action research that aims to improve the mastery of cell transport concepts and their ability to write scientific papers through online learning. The research was conducted in class XI MIPA 1 at SMA Negeri 2 Purwakarta with 36 students with three cycles of treatment using a constructivist approach with a modified inquiry model. Each cycle is based on a reflection of the previous cycle. The test result data in each cycle is analyzed by comparing the data before and after treatment. Observation data about scientific writing components was analyzed to identify difficulties experienced by students. The results showed that the average learning outcomes for mastery concepts increased by 54.2% using the N-gain score, which means that the treatment significantly impacts mastering the concept of cell transport. The ability of scientific writing papers shows an increase of 11.25%. These classroom action research results show that making scientific writing papers can improve mastery of cell transport, and this may be a recommendation for teaching methods on other concepts.

Abstrak

Kegiatan pembelajaran dilaksanakan secara daring selama pandemi covid 19. Kemampuan peserta didik dalam menulis karya ilmiah biologi dan menerapkannya dalam dunia nyata penting ditingkatkan, bahkan presentasi saat belajar jarak jauh. Penelitian ini merupakan penelitian tindakan kelas yang bertujuan untuk meningkatkan penguasaan konsep transportasi sel, dan meningkatkan kemampuan menulis karya ilmiah dengan pembelajaran daring. Penelitian ini dilaksanakan di kelas XI MIPA 1 SMA Negeri 2 Purwakarta yang berjumlah 36 siswa, dengan perlakuan 3 siklus menggunakan pendekatan *konstruktivisme* dengan model inkuiri yang dimodifikasi. Setiap siklus didasarkan pada refleksi dari siklus sebelumnya. Data hasil tes setiap siklus dianalisis dengan membandingkan data sebelum dan sesudah perlakuan. Data observasi tentang komponen penulisan ilmiah dianalisis untuk mengidentifikasi kesulitan yang dialami siswa. Hasil penelitian menunjukkan bahwa rata-rata hasil belajar penguasaan konsep meningkat sebesar 54,2% dengan menggunakan skor N-gain yang berarti perlakuan berpengaruh signifikan terhadap penguasaan konsep transportasi sel. Kemampuan menulis karya ilmiah menunjukkan peningkatan sebesar 11,25%. Hasil penelitian tindakan kelas ini menunjukkan bahwa pembuatan karya tulis ilmiah dapat meningkatkan penguasaan konsep transportasi sel, dan dapat menjadi rekomendasi metode pengajaran pada konsep lainnya.

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A. Introduction

The ability to communicate is something that absolutely must be mastered by students in the era of education that focuses on learning activities for students (student-centred learning). The ability to speak and write are two things that must be actively carried out to increase productivity. Compared to speaking ability, writing is seen as a more difficult skill (Kern & Schultz, 2005). Written communication is writing effectively in many contexts and directed for various audiences with diverse purposes (Sparks et al., 2014). Written communication requires academic skills, editing, critical reading, and the ability to display representative data (Hohenshell & Hand, 2006; Wallace & Wray, 2021). One of the ways that students can practice their writing skills is by writing scientific papers.

Writing a scientific paper is often still seen as something that is done and only produced by specific individuals and limited to experts. In any science, anyone can write scientific papers, including teachers and students. The scientific characteristics of a scientific paper are indeed seen from the content, presentation, and language used. Scientific writing activities generally convey new knowledge and findings in a written language (Moses & Mohamad, 2019; Supriyanto, 2020). Class XII MIPA 1 students as research subjects cannot yet write scientific papers, especially research results related to Biology concepts. In understanding Biology, students only do practical work without using context in everyday life.

Theoretically, the concept of biology as a learning subject can be learned in class, but deeper understanding often has to be done through simple research by students. The research of cell transport material during the last 20 years is a difficult concept for students to understand. Students have inadequate conceptions of diffusion and osmosis or stated that their understanding of these concepts is insufficient (Hasni et al., 2016). They understand how the cell membrane must precede diffusion and osmosis work because its permeability allows water, ions, and other substances to be in or out of the cell (Larsson, 2012). So far, giving concepts to students is still through explanations by the teacher, without providing learning experiences through research. The inquiry learning experience provided was only limited to the laboratory's osmosis experiments, which were not contextual. Students have not been invited to examine the phenomenon of osmosis and diffusion in everyday life by applying the principles of osmosis and diffusion. The making process of French fries, chips, kimchi, and pickles is an everyday phenomenon that can be investigated to strengthen the concept of cell transport. Students can choose these phenomena to understand the concepts of diffusion and osmosis.

The transition of learning in Indonesia (even worldwide) from offline to online since the pandemic at the end of 2019 has widely changed students' learning conditions. Students who are used to getting direct feedback while studying cannot receive it anymore. The problems faced by changing learning patterns are not only faced by students but what is more visible is the problem of the lack of teacher literacy with how online learning should be carried out. The evaluation results at SMA Negeri 2 Purwakarta showed that 80% of teachers only used WhatsApp social media platforms to learn online. They are learning in the form of assignments, submitted in the form of photos or short videos, without any feedback regarding the results of the submitted assignments. As a result, as explained earlier, students tend to wait and be confused about what the next lesson will be. Students' creativity, previously high in processing various tasks, now seems to have stopped with online learning.

Based on the problems above, it is necessary to strengthen and adjust learning during the pandemic by creating scientific papers. Although learning must be done online, this is not a barrier to implementing contextual science learning in students' homes. The phenomena of osmosis and diffusion in everyday life are making: 1) French fries, fried onions, kimchi, and pickles. Hopefully, this could be a bridge to show how cell transport occurs in many things around the students. In this regard, the question is whether writing scientific writing during online classes during a pandemic can help students understand the concept of cell transportation.

Online learning is not a new thing in the education field. Most developed countries have been using online learning to expand the education range, improve the quality of teaching, and reduce the cost of teaching if done offline (Bakia et al., 2012; Nuraiman et al., 2023). In addition, online learning pays attention to its effectiveness in educating students, its use as teacher professional development, cost-effectiveness to combat rising education costs, equal value for students following equivalency, and the possibility of providing world-class education to anyone with an internet connection anywhere, anytime, and anyone (Nguyen, 2015).

The pandemic at the end of 2019 has forced all countries in the education aspect to change

traditional teaching patterns to online and blended learning, including Indonesia. However, this has resulted in obstacles because the infrastructure has never been mass-ready for online teaching. Online learning platforms such as Edmodo, Google Classroom, Cisco Webex, Microsoft for Education, Quipper, Learning House, Desk Kita, Icando, IndonesiaX, and others are currently widely used at various levels of education (Hasibuan et al., 2021). The government itself provides a Google suite for education platforms by providing learning.id account for students and teachers so that learning can still be implemented even in a lockdown.

Teaching students to write scientifically is part of building critical, creative thinking skills, inquiry, growing the soul of a researcher and reconstructing understanding in any situation (Balgopal et al., 2018; Kraus, 2009; Krest & Carle, 1999). Students who are given learning by conducting experiments and writing down their results through scientific writing develop the ability to rethink, rewrite, and self-summarize what they think and do to convince others about the results of their research (Anisa et al., 2019; Anisa et al., 2022).

The criteria for scientific writing require several components to make it easier for readers to understand the flow of thoughts and research results. The researcher aims to show continuity and logical flow of ideas supported by research evidence (Balgopal et al., 2018; Nuntasane et al., 2020; Yazar Soyadı, 2015). Therefore, writing must use language with appropriate, clear, interesting, informative context and the ability to convince the reader to agree with the claims (Takao & Kelly, 2003; Whithaus, 2012). The writing systematics follows the following rules: the research title, abstract, introduction, theoretical basis, research method, results, discussion, conclusions, and references (Boehm, 1953).

Simple research on membrane transportation can be done at home during online learning by using various materials or tools around the interaction to interact with many people. Cell transport is a phenomenon, not just a theoretical one presented in the book (Larsson, 2012; Rundgren et al., 2010). This means that students can understand the concept of cell transport and use its working principles in everyday life.

B. Method

This one is a classroom action research with three research stages covering four steps, namely: 1) Plan: This stage involves identifying problems, analyzing problems systematically, formulating research questions, outlining a strategic plan of Action to address the identified problems; 2) Act: This stage involves implementing a strategy and several interventions or actions to address the problem; 3) Observe: This stage involves observing the results of the strategic plan and evaluating the actions taken in the previous stage with appropriate methods and techniques; and 4) Reflect: This stage involves critically reflecting on the evaluation results and all actions and identifying a new plan. Schematically, this class action research step can be seen more clearly in Figure 1. It can be seen that the four stages of Action will be repeated if the results of reflection indicate the need for improvement due to the research objectives that have not been achieved.

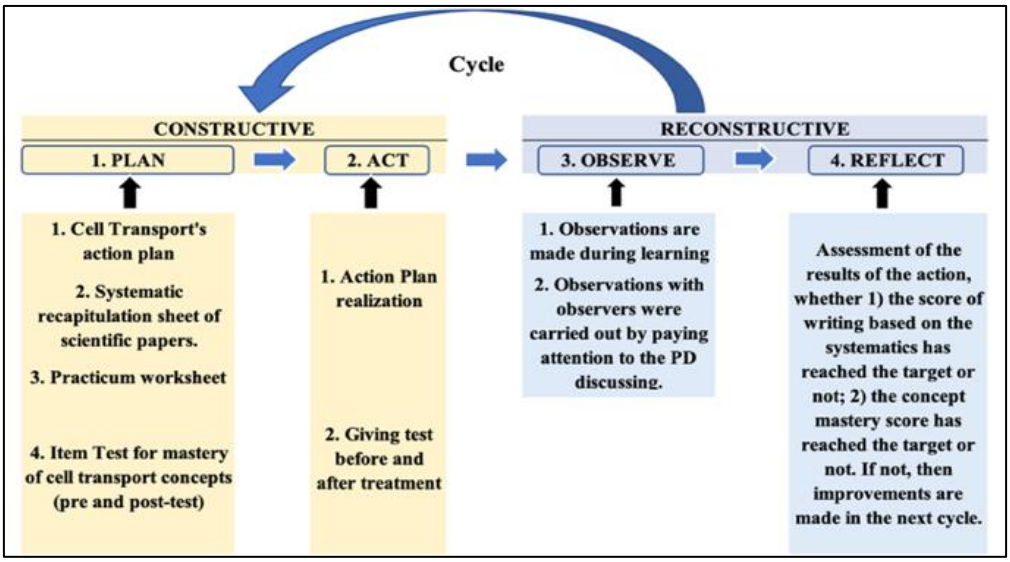

Figure 1
Cycle scheme carried out in research

The research subjects were 35 class XI Science 1 students, with 21 female students and 14 male students in the 2021-2022 academic year at SMA Negeri 2 Purwakarta. This classroom action research was carried out in the 1st semester of the 2021-2022 academic year. Each cycle lasts 2 hours of lessons with one learning hour @ 45 minutes online using Google Classroom and a belajar.id account that the Ministry of Education has provided. So, a total of 90 minutes for each online meeting. The observers involved were the class X Biology teacher from cycle I to cycle III (The research stopped in cycle III because the research objectives had been achieved). The teaching material that will be given is about cell transport and the factors that affect cell transport. The questions are 15 multiple choice questions with a C1 distribution of 15%, C2 20%, C3 30%, C4 20%, and C6 15%. The test instrument consists of questions validated in other classes with a reliability value of 0.640. Student worksheets in the form of proposal templates and report templates, and the teacher's observation sheet regarding the activities of students during class learning.

Cycle I conveys learning objectives that must be achieved based on basic competency knowledge and skills. From the results of cycle I, students are given a pretest at the beginning of cycle II and then a post-test at the end of cycle III. The pre and post-test results were analyzed for average changes, and the score changes were seen to see whether they had increased or decreased. Apart from test data, students' progress in making research proposals and reports is analyzed at each stage to see the development of their ability to write scientific papers. These two things are used as indicators of research success.

C. Results and Discussion

The results of observations and reflections from the implementation of the planning carried out in the first cycle have not been able to measure the achievement of mastery of the concept of cell transport because the first cycle aims to provide an understanding of how to conduct research and how to make reports. Students were trained to ask questions using question words that cause critical thinking, which used an interrogative sentence using what, how, and why. Questions with the question words how and why are types of questions of high quality due to the need for evidence to answer these questions (Song, 2016).

Among the types of questions asked by students, only five questions occur using the question word 'How'; 4 questions with 'Why'; and 12 questions using the word 'What'. This is used as one of the reinforcements to direct students to solve problems in the research they do. At the end of the first cycle, several research themes were obtained. Namely, three groups chose to make French fries; one made fried onions, and two made potato chips. The systematics of writing essays has also been introduced in the first cycle because students must align the problems raised with possible answers to make a report as a scientific paper.

Initial findings obtained in cycle I showed that students had never made research proposals and reports. So, the researcher and the observer decided to introduce how to make a proposal using the research context chosen by the students (making kimchi, fried onions, French fries, or chips) in cycle II.

Findings from observations and reflections in cycle II were able to obtain student learning outcomes in cell transport material. The types of questions asked have also increased: using the question word 'what' in as many as 36 questions; using the question word 'how' in as many as 30 questions; using the question word 'Why' in as many as 20 questions. According to that result, the focus of the question has led to training students' critical thinking aspect so that the prediction of the answers could be made in the form of a process. In other words, the research design outlined in the research proposal is a work step to answer the predicted answers that the students might ask themselves. Cycle II also revealed that students had difficulties making proposals in several aspects, as shown in Figure 2.

Why is asking this an important thing to practice? According to Shanmugavelu, asking questions is one way to attract students' attention or concentration so that students focus on learning (Shanmugavelu et al., 2020). Teachers and students must be able to ask the right questions (Duit et al., 2008; Kelana et al., 2022). If the goal is to develop critical thinking skills, then the appropriate question word is to use the word "how". This word will require a process answer; it can be predicted and proven (Cotton, 1988). The results of the proof can be used as a report, which is the result and realization of ideas carried out by students.

Figure 2 shows that 56.1% of students have difficulty adjusting the writing systematic, followed by difficulty making a hypothesis by 48.8% and determining the research question by 26.8%. Thus, makes the reflection to provide suggestions for following up on these difficulties to provide personal and group guidance on how to write scientific papers according to the systematics; then guide to make hypotheses Ha and H0; also continue

to practice their ability to ask questions so that they can bring up the thinking process in making their reports. Next is the result of mastering the concept of cell transport, which was insufficient.

This means that students have difficulty in the linguistic part of writing proposals. This was also conveyed in research conducted by Rastri, who obtained data that there were three aspects of difficulties experienced by students when writing proposals, namely psychological, sociocultural and linguistic factors (Rastri et al., 2023). Linguistic factors are related to writers' language knowledge, including deleting, replacing, supplying or reordering to repair the sentence.

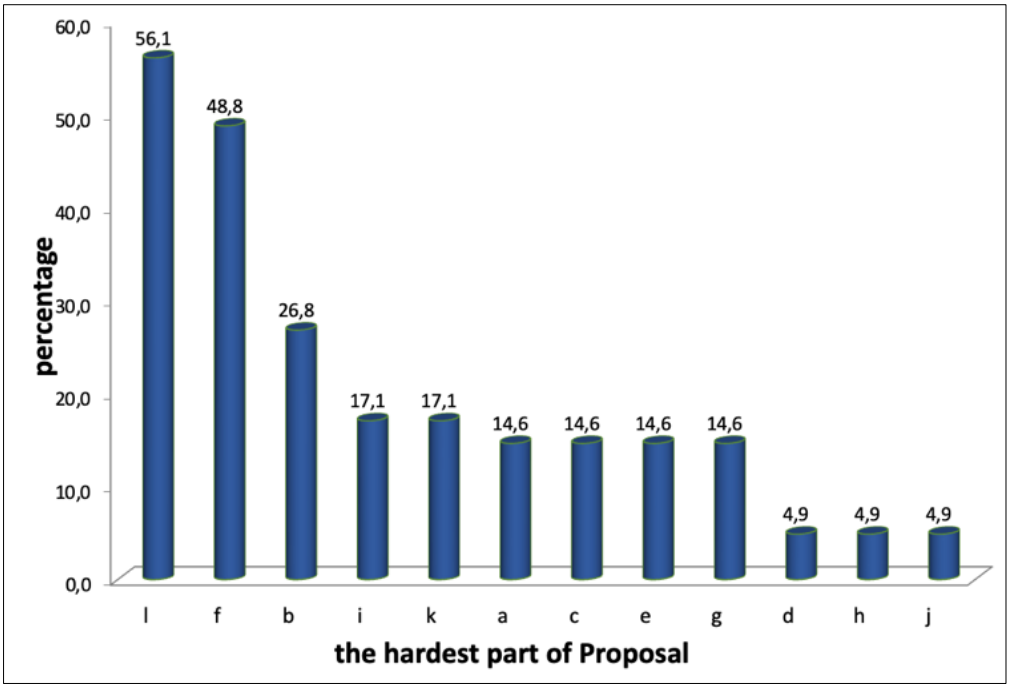

Figure 2
Types of students' difficulties in making research proposals

Description:

a = Title	d = Benefit of research	g = Variability	j = Tools and materials
b = Research question	e = Introduction	h = References	k = Time to do research
c = Research purposes	f = Hypothesis	i = Research method	l = Systematic of writing

The average value obtained in this sub-summative test is 37.5, which means that the result is still below the minimum completeness criteria set for XI graders in Biology with a minimum score of 70. This shows that in the second research cycle, students who are still below the standard are still very large, around 35 people. The analysis results later prove that the students have not been able to master the cause and effect and the interrelation of all components that cause cell transport by osmosis and diffusion.

The following result showed better development in the third cycle after the teacher's guidance on scientific writing. Based on observations by observers, students' activeness reached 95.12% on average in learning involvement in class and when conducting research. Cycle III displays reports for each group online via Google Meet and lasts for two meetings. Calling students from each group to appear is executed randomly so that the teacher can figure out the readiness of each individual to master the material. At the end of the presentation, a test was conducted with questions equivalent to the second cycle, and an average of 91.70 was obtained, meaning that there was an increase of 54.2% by 54.2% using N Gain score, which means that the treatment has a significant impact on mastering the concept of cell transport. Based on Table 1 result, the treatment from 2nd cycle significantly impacts mastering the cell transport concept.

Identifying students' difficulties in writing Chapter IV and Chapter V is known by seeing the questionnaire results given in the 3rd cycle at the 3rd meeting. Questionnaires were given to students via Google Forms regarding the difficulties they faced when making proposals and difficulties in making research reports. The results of the identification are shown in Figure 3 below. The results of the questionnaire in Figure 3 show the

highest difficulty in making Chapter IV and Chapter V faced by students, namely interpreting images (graphs and charts) at 51.2%, followed by 46.3% difficulty in drawing pictures; 41.5% followed by complex scientific paper writing systematic rules; 19.5% interpreted the table; 17.1% find it challenging to discuss and relate it to similar research results; 14.6% have difficulty making tables and linking material with literature review; 12.2% had difficulty concluding; and 8.8% difficulty in making suggestions.

It can be seen in Figure 3 that only 20% of students cannot interpret the data. This means that most students can interpret the results in the material from the research results. This explains the high mastery of cell transport concept test results. Understanding concepts with research will provide meaningful and long-term understanding to students because of their involvement in proving their curiosity about contextual cell transport problems (Rayment et al., 2022; Shana & Abulibdeh, 2020).

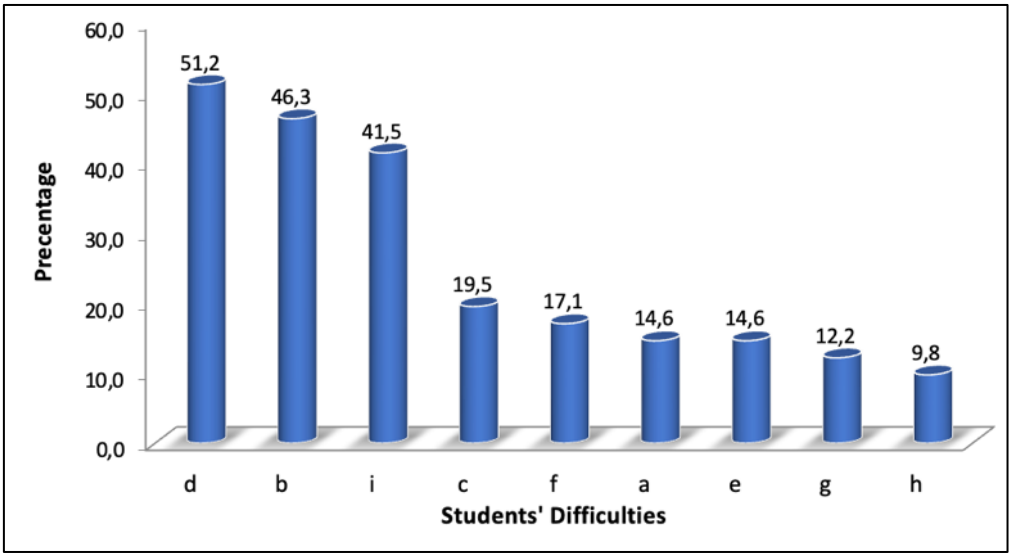

Figure 3
Types of students' difficulties in making chapter IV and chapter V

Description:
a = Table
b = Figure
c = Table interpretation
d = Figure interpretation
e = Analyses data
f = Result interpretation
g = Conclusions
h = References
i = Systematic of writing

Table 1 The Quality Improvement of Scientific Paper

Category	1st Guidance (%)	2nd Guidance (%)	Result Change from 1st to 2nd Guidance (%)
+	40	53.75	13.75
++	16.25	35	18.75
-	20	11.25	8.75
- -	3.75	0	3.75
Overall Upgrade percentage			11.25

Description:
++ = According to writing standard of scientific paper
+ = Meet writing standards of scientific paper
- = Insufficient writing standard of scientific paper
- - = Not sufficient writing standard of scientific paper

Although the results show significant results, it still has something to consider several aspects that can cause bias in student learning outcomes. Students are very likely to use the Google search engine to look for answers to the tests given, especially when the tests are taken online without the teacher being directly present to supervise the exam process. This is an obstacle faced by all teachers who teach online classes. Even though teachers use the best platform, students may have multiple devices, so cheating can still be done (McGee, 2013; St-Onge et al., 2022).

However, the researchers did not rule out the possibility that the test was the students' true ability. Since there is an apparent demand for scientific writing, it could be one of the main

parameters for achieving the Basic Competencies. The mentoring assessment conducted twice by the teacher, namely when making proposals and research reports, showed an increase in the ability to write scientific papers. More clearly can be seen in Table 1.

Based on Table 1, the largest percentage that does not meet the scientific paper writing standards is on the systematic writing item. This can be understood because students do not know about scientific papers and various learning opportunities. Making a hypothesis is the next difficulty, which is also quite high. This might be due to the process of making it requires a fairly high analytical ability. Students must be able to analyse various variables that affect an object of research, find out what problems occur to these variables, and then determine the hypothesis of whether a variable can affect an object or not. The cause of the low ability of students to determine hypotheses in class XI Science 1 needs further research on their critical thinking skills, so it cannot be revealed in this action research what causes these findings.

Getting familiar with making an excellent scientific paper takes a lot of time. Writing is a skill that not all students have naturally. The ability to write scientific papers is a skill that must be trained and developed based on empirical experience. Four weeks is a very short time to be able to practice these skills, so high appreciation needs to be given to students who have tried to improve their scientific paper writing skills to reach an increase of 11.25% from the situation they have never made it correctly.

D. Conclusion

Two conclusions can be drawn Based on the research carried out during the cycle in four face-to-face and non-face-to-face (online) meetings for class XI Science 1 students at SMA Negeri 2 Purwakarta. Namely, research and writing activities on scientific papers can increase the average learning outcomes of students in cell transportation material by 54.2%. They can improve their scientific writing skills by 11.25%. While writing scientific papers, students will try to answer the research questions posed in the proposal. This process increases the ability to master concepts regarding cell transportation. Students discuss with each other, explore information on the internet, and also hold discussions with the teacher to find a deeper understanding of concepts. This inquiry process led to an increased understanding of cell transport. This provides a recommendation that the habit of making scientific papers from a young age will sharpen students' ability to think scientifically. Regular sequences and systematics will guide students to think analytically and further to think creatively. In conclusion, writing scientific papers during the pandemic can significantly increase understanding of Biology concepts, especially in the context of Cell Biology.

E. Acknowledgement

Thank you to the students in XI IPA 1 who have followed the learning process through making scientific papers and to Mrs Dyah Kartikasari, who has assisted as an observer in this classroom action research.

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