BIOLOGY TEACHERS' TPACK SELF-EFFICACY IN PRACTICAL WORK DURING DISTANCE LEARNING

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Abstract:

This study aims to explore Biology teachers' TPACK self-efficacy on practical work during distance learning. The descriptive method was used with 42 participants who joined as Biology teacher association in Garut city, determined by random sampling. The data were collected through an online self-assessment questionnaire to explore teachers' perceived self-efficacy. Data analysis is done descriptively. The results showed that biology teachers have a good self-efficacy on their TPACK. Biology teachers are confident that they will carry out practical work successfully during this pandemic crisis. Biology teachers tend to show better self-efficacy in content knowledge than knowledge related to technology. However, they generally still show enthusiasm to increase their technological knowledge. The results indicate sustained integration of technology in learning even after the COVID-19 crisis, for example, when blended learning is in the future. This research may be used to develop a professional program to improve teachers' TPACK.

Abstrak:

Penelitian ini bertujuan untuk mengeksplorasi self-efficacy guru Biologi terhadap TPACK pada kegiatan praktikum selama pembelajaran jarak jauh. Metode deskriptif digunakan dalam penelitian ini dengan melibatkan 42 guru yang tergabung sebagai anggota musyawarah guru mata pelajaran Biologi di Kota Garut dan dipilih secara acak. Data dikumpulkan melalui kuesioner penilaian diri untuk mengeksplorasi self-efficacy yang dimiliki guru. Analisis data dilakukan secara deskriptif. Hasil penelitian menunjukkan bahwa guru Biologi memiliki self-efficacy yang baik pada TPACK mereka. Guru Biologi percaya diri bahwa mereka bisa melaksanakan kegiatan praktikum dengan sukses selama pandemi COVID-19. Guru Biologi cenderung menunjukkan self-efficacy yang lebih baik dalam hal pengetahuan konten, jika dibandingkan dengan pengetahuan yang berkaitan dengan teknologi. Tetapi umumnya tetap menunjukkan antusias untuk meningkatkan pengetahuan teknologinya. Hasil penelitian ini mengindikasikan potensi integrasi teknologi yang berkelanjutan dalam praktikum berbasis online terutama ketika blended learning menjadi keharusan setelah melewati masa krisis pandemi COVID-19. Hasil penelitian ini dapat dijadikan dasar untuk mengembangkan program profesionalisme guru dalam meningkatkan kemampuan TPACK.

Keywords:

Biology Teacher, Distance Learning, Practical Work, Self-Efficacy, TPACK

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INTRODUCTION

Biology as part of science has many elements, including tools and products, the human element of science, and science knowledge and its limits (McComas, 2015). These elements show that biology is not just knowledge but more complex than that (Reiss, Millar, & Osborne, 1999). This character of biology will affect how teachers teach and how students learn (Tanner & Allen, 2004). Biological learning is obliged to communicate or interact with these elements thoroughly (Jeronen, Palmberg, & Panula, 2017; Lederman N., Lederman J., & Antink, 2013). One of the learning activities that have the potential to cover these needs is practical work. Practical work is an essential component in learning and teaching activities, which can develop students' scientific knowledge and knowledge of science as a whole (Millar, 2004). Through practical work, students can make observations, manipulate objects, interact with actual materials, and associate them with ideas or concepts so that students can learn all elements of biology (Abrahams & Millar, 2008). As important figures in learning, teachers are expected to have the competence to conduct practical work well (Pekmez, Johnson, & Gott, 2005). Teachers must transform their biological content into appropriate practicum activities and initiate students to learn or often called pedagogical content knowledge (PCK) (Shulman, 1986).

It is not enough just with teachers' PCK, and now teachers are faced with a new challenge, integrating technology in learning (König, Jäger-Biela, & Glutsch, 2020). After the COVID-19 pandemic, integrating technology in learning is no longer an option but becomes necessary because learning activities are carried out through distance learning (Liguori & Winkler, 2020). Distance learning will work well if supported by the teacher's knowledge of technology and the teacher's ability to integrate technology into his learning (Anderson, Barham, & Northcote, 2013). This kind of knowledge is known as technological pedagogical content knowledge (TPACK). TPACK is defined as competence in integrating knowledge about content, pedagogy, and technology in learning activities (Koehler & Mishra, 2006; Schmidt, Thompson, Koehler, & Shin, 2014). Therefore, it is needed to know how teachers' TPACK in carrying out practical work during distance learning.

As an effort to carry out learning during the COVID-19 pandemic crisis, not only required knowledge and skills, teachers are also required to have confidence in their success in running distance learning, especially in practical work (Brinson, 2015). The belief that a teacher has in his or her capacity to cope with learning while in unfamiliar conditions is part of a critical competency (Lauermann & König, 2016). Bandura (1997) revealed that teacher self-efficacy denotes teachers' beliefs about their abilities to succeed in specific situations (Flammer, 2015). Self-efficacy can also be a significant barrier for teachers in learning, including applying technology (Ertmer, P., Anne, O.-L., & Tondeur, 2015). Those research show that self-efficacy is essential for a teacher conducting online learning.

Previous research shows a balanced relationship between teacher TPACK and self-efficacy (Corry & Stella, 2018). Other research on teachers' self-efficacy in online learning (Dolighan & Owen, 2021) mentions that teachers already have good beliefs when using

learning management systems. However, there is no detailed information on the teacher's belief when facing practical work during distance learning. Therefore, it is crucial to identify the teachers' self-efficacy of their TPACK in conducting practical work during distance learning while in this COVID-19 pandemic crisis.

This research aims to explore Biology teachers' self-efficacy on their TPACK in design practical work during distance learning. This study expects to reveal the possibility of implementing TPACK and improve teachers' competences in practical work during or beyond the COVID-19 pandemic situation.

RESEARCH METHOD

This study used a descriptive method to explore teachers' TPACK self-efficacy (Bennett, Borg, & Gall, 1984). This method informs about what is happening, opportunities, or other aspects of one phenomenon that had not previously been understood (Loeb, Dynarski, McFarland, Morris, Reardon, & Reber, 2017). This study provides an overview of biology teacher self-efficacy on their TPACK in practical work during distance learning. The research subject was 42 teachers from various schools members of a Biology teacher association in Garut city, determined by random sampling. Teachers' demographic data are shown in Table 1.

Table 1. Participants Demographic

Demographics Variable	N	%
Gender		
Male	6	14.28
Female	36	85.72
Teaching Experience		
< 5 years	9	21.42
5-10 years	7	16.67
10-15 years	8	19.04
15-20 years	9	21.42
>20 years	8	19.04
School Status		
Public	31	73.81
Private	11	26.19

Data collection was done through a self-assessment questionnaire and online interview. This questionnaire was adapted from previous research (Chai, Hong, & Koh, 2013; Schmidt, Thompson, Koehler, & Shin, 2014). The development of this instrument was adjusted to teachers' beliefs, biology content, and the integration of technology on practical work during distance learning. The instrument consisted of 30 items statements that asked participants to rate their perceived self-efficacy for their TPACK on practical work during distance learning. Participants answered each statement using five-level Likert. An example of the self-assessment questionnaire used is shown in Table 2. Three open-ended questions were added to closely determine teacher perception of integrating

technology on practical work after pandemic related to challenges and learning process in practice. The self-assessment questionnaire covers all seven components of TPACK. The instrument was validated through two experts then conducted a readability test. Furthermore, to obtain more in-depth information about the state teacher self-efficacy of TPACK, the researchers interviewed two teachers. These two teachers have chosen based on their answers to the open-ended question section on the questionnaire that represents two typical patterns about teachers' self-efficacy on online-based practical work. The answers they gave were able to describe more about the state of Biology teacher self-efficacy.

The data were analyzed through two stages. First, quantitative data from five-level Likert scale questionnaires will be processed through interval class analysis (Nuryadi, Astuti, Utami, & Budiantara, 2017). The mean for each component TPACK was calculated and add together to produce a total mean score. Then through descriptive analysis (Loeb, Dynarski, McFarland, Morris, Reardon, & Reber, 2017), the researchers characterized a phenomenon; and identified patterns in data to answer research questions on how Biology teachers self-efficacy toward their TPACK on designing practical work during distance learning.

Table 2. Example of Self-Statement Questionnaire

Component	N	Statement
CK	4	I have sufficient knowledge about biology.
PK	6	I know how to organize practical work.
TK	5	I have the technical skill to use technology.
PCK	5	I can design practical work to guide student scientific process skills.
TCK	2	I know technologies that I can use for understanding biology content.
TPK	4	I can choose technologies that enhance practical work during distance learning.
TPACK	7	I can organize teaching during distance learning that appropriately combines biology, practical work, and technologies.

RESULTS AND DISCUSSION

The Biology teachers' self-efficacy toward their TPACK on designing practical work during distance learning is shown in table 3. Overall, teachers' self-efficacy on their TPACK on practical work during distance learning is in a “good” category. Out of the seven components, content knowledge is the only one in a “very good” category. Meanwhile, the rest of the components are in a “good” category.

Table 3. Biology Teachers’ TPACK Self-Efficacy on Practical work

Components of TPACK	Mean	Category
Content knowledge (CK)	4.23	Very good
Technology knowledge (TK)	4.05	Good

Pedagogical knowledge (PK)	4.05	Good
Pedagogical content knowledge (PCK)	3.53	Good
Technological content knowledge (TCK)	3.68	Good
Technological pedagogical knowledge (TPK)	3.58	Good
Technological pedagogical content knowledge (TPACK)	3.85	Good

This result shows that teachers are confident that they will carry out practical work successfully during this pandemic crisis. This attitude was supported by the fact that 80% of participants have been teaching for more than five years. Other studies show that teaching experience does contribute positively to effectiveness in learning (Podolsky, Kini, & Darling-Hammond, 2019). Teachers with experience know how to organize practical work, are familiar with student needs, and adjust learning strategies with various conditions (Kleickmann, Richter, Elsner, & Baumert, 2013).

Self-Efficacy on Content Knowledge (CK)

Content knowledge is the knowledge about an actual subject matter to be learned or taught (Koehler & Mishra, 2006). A teacher must know about biology as a subject matter they are going to teach and how the nature of biology as knowledge is different from other subjects. Teachers who interact with content knowledge well is known as subject matter expert. Data shows that Biology teachers have excellent self-efficacy on content knowledge. The belief that teachers have in this study is essential because teachers who have confidence as a subject specialist positively correlate with student achievement (Förtsch, Werner, Kotzebue, & Neuhaus, 2016). The previous study has shown a similar statement that subject matter competence and self-perceptions of effective instruction established levels of teacher efficacy that disputed the necessity for pedagogical knowledge growth (Diezmann & Watters, 2015).

Self-efficacy in content knowledge can be seen from 4 indicators: teachers believe that they have sufficient knowledge about biology; they can identify characteristics of every single topic on biology; they know biology's nature of science; and they have various ways and strategies of developing their understanding of biology. Biology teachers must know the subject they teach, and this is fundamental for teacher competency. Teachers who know a subject well are likely to have the knowledge they need to help a student learn (Loewenberg Ball, Thames, & Phelps, 2008). However, just knowing a subject thoroughly is not always enough for a teacher. In addition, the teachers must know the nature of science of their subject or knowledge. Teachers must know and identify how biology differs from other knowledge (McComas, 2015) and how biology has its characteristics (Reiss, Millar, & Osborne, 1999). A teacher is also led to become an active learner or develop his knowledge about a subject matter. The content that a teacher delivers to his or her students should be up-to-date and reflect the latest scientific facts. Therefore, teachers need to have various ways or strategies to develop content knowledge as subject matter experts. Other research shows that content knowledge development can be valuable for self-efficacy (Swackhamer, Koellner, Basile, & Kimbrough, 2009). The data shows that 3 out of 4 indicators are in the "very good"

category. Biology teachers are comfortable with their content knowledge, which is a good sign of those statements.

Although the data show that teacher self-efficacy on content knowledge is in the "very good" category, further studies are needed on whether Biology teachers actually have good content knowledge. Another study stated a negative relationship between ones' belief that they could teach science effectively and their science score, meaning that the more science of self-efficacy they possessed, the lower their science of knowledge (Catalano & Durkin, 2019).

Self-Efficacy on Pedagogical Knowledge (PK)

A teacher cannot succeed if he cannot convey his knowledge to his students, no matter how competent he is in the subject matter. So that, pedagogical knowledge is another competency that needs to be possessed by a teacher. Pedagogical knowledge includes methods and processes of teaching that cover knowledge in classroom management, assessment, and student learning (Schmidt, Baran, Thompson, Mishra, Koehler, & Shin, 2009). Pedagogical knowledge in this study refers to how teachers carry out practical work in student learning. A teacher who knows how to carry out practical work well understands how students construct knowledge, acquire scientific process skills, develop habits of mind, and have a positive attitude toward learning (Millar, 2004).

The data show that teachers' belief in their pedagogical content is categorized as "good", meaning that teachers believe that they can manage well practical work in student learning. A teacher with high self-efficacy tends to explore more alternative methods of instruction, seek improved teaching methods, and experiment more extensively with instructional materials (Allinder, 1994).

Self-efficacy on pedagogical knowledge can be seen through six indicators, which is: teacher knows how to plan practical work, how to organize all elements on practical work, what kind of difficulty student might find on practical work, how to enhance student science process skill with practical work, how to evaluate student learning in a variety of ways, and how to adapt their practical work based upon what students currently understand or do not understand. All indicators show that teacher self-efficacy on pedagogical knowledge is in a "good" category, except for what kind of difficulty students might find on practical work is in a "very good" category. Teachers with experience can quickly identify student difficulty because they have faced repeated situations and found student patterns. It becomes a provision to predict the difficulties of students (Kleickmann, Richter, Elsner, & Baumert, 2013). Teachers who are already mature on pedagogical knowledge can see the condition of students and adjust the way they teach (Anwar, Rustaman, Widodo, & Redjeki, 2014). Additional research shows that teachers with high self-efficacy have a more humanistic perspective in responding to the students, while teachers with low teaching efficacy have strict responses (Woolfolk, Rosoff, & Hoy, 1990).

Self-Efficacy on Pedagogical Content Knowledge (PCK)

Teachers often perceive that becoming an expert in subject matter is the most crucial factor in teaching (Fisher & Webb, 2006). However, perception on the importance of content specialists has shifted along with research findings that teachers with good content knowledge do not guarantee effective learning (Mthethwa-Kunene, Onwu, & de Villiers, 2015). Therefore, it is needed teachers who not only experts in content areas but also must know the character of the content and how to make students learn through the content or often called pedagogical content knowledge.

Pedagogical content knowledge is the content knowledge that interacts with process of teaching (Shulman, 1986). Pedagogical content knowledge is distinct from other types of content knowledge because it combines both content and pedagogy to improve teaching practices in the content areas. Teachers who have comprehensive knowledge of their subject matters and teaching process let their students actively participate in the lessons (Förtsch, Werner, Kotzebue, & Neuhaus, 2016).

Pedagogical content knowledge in this study refers to teacher knowledge on how to make students learn biological content through practical work. The data show that teachers have a good belief in their pedagogical content knowledge, meaning that they are confident in representing biology content through practical work. This data is in line with another study showing that pedagogical content knowledge and efficacy beliefs are highly correlated and influence one another (Thomson, DiFrancesca, Carrier, & Lee, 2017). Additional research from Netherland (Velthuis, Fisser, & Pieters, 2014) showed that general science course content and the methods courses that preservice teachers took during their teacher training impacted their efficacy, especially in their early years of training.

Self-efficacy on pedagogical content knowledge can be seen on three indicators: identify content biology that needs practical work as a teaching method, select effective practical work to guide student thinking and learning in biology, and anticipate student misconceptions. Data shows all indicators of teachers' self-efficacy on pedagogical content knowledge in a good category. Teacher's self-efficacy on their pedagogical content knowledge is essentials. It helps teachers set their intention to develop students' understanding of biology and science process skills through practical work during this challenging time.

As we know, biology content has a broad scope (Reiss, Millar, & Osborne, 1999), starting from microscopic to macroscopy, ranging from abstract to concrete concept, ranging from facts to theories and even law. So, every topic in biology has its potential, which can be learned through various learning methods. In addition, the forms of practical work as a learning method are very diverse; there are expository, inquiry, discovery, and problem-based practical work (Domin, 1999). To conduct practical work, teachers need specific knowledge about the potential subject of biology that can be delivered to students through practical work. Besides that, a teacher needs to possess knowledge on identifying student misconceptions. A teacher's ability to identify students' difficulty in understanding a subject matter is a form of pedagogical content knowledge,

and it is a part of science teacher competence (Sadler, Sonnert, Coyle, Cook-Smith, & Miller, 2013).

Self-Efficacy on Technological Knowledge (TK)

Technology is something that humans need every day, including teachers. Teachers must know various technologies, ranging from simple technologies such as pencil and paper to digital technologies such as the internet, digital book, and software programs known as technological knowledge (Schmidt, Baran, Thompson, Mishra, Koehler, & Shin, 2009). Technological knowledge in this study refers to teacher knowledge about technologies that they are familiar with. The data showed that teachers have good self-efficacy on their technological knowledge. Most of them believe they know many different technologies, can learn technology efficiently, and keep up with new technologies. So, they seem to have confidence and a positive attitude on technologies. However, they have less confidence or belief when it comes to solving their technological problems. An additional study comes from Bakar, Maat, & Rosli, (2018), who said that self-efficacy plays a vital role for teachers to adopt technologies. Another study finds something interesting (Letwinsky, 2017), who stated that although there is a high self-efficacy among teachers, data revealed a teacher's minimal use of technology. So, further research is needed to investigate the use of technology to find the relationship between teachers' self-efficacy and technological knowledge.

Self-Efficacy on Technological Pedagogical Knowledge (TPK)

Teachers are expected to use technology in various ways, including their learning process, especially in this pandemic era when distance learning is necessary. Technological pedagogical knowledge means how various technologies can be utilized in learning and transform the way teachers teach (Schmidt, Baran, Thompson, Mishra, Koehler, & Shin, 2009). Technological pedagogical knowledge in this study refers to how digital and internet-based technology can be used in practical work during distance learning. The data showed that teachers show good self-efficacy in their technological pedagogical knowledge. Teachers believe they can operate technology well for practical work in distance learning and choose technologies that enhance students' hands-on skills. Overall, teachers believe that integrating technology in student learning while on distance learning can be done well. Data is in line with another study that says the effectiveness of technology integration in learning will enhance teachers' positive feelings toward using technology (Giles & Kent, 2016).

Teachers say that they join various programs held by teacher associations, collage, and local governments about various tools and technologies devices can use for practical work while in distance learning. They find those programs help them a lot in going through learning challenges during a pandemic crisis. Other research (Hatlevik & Hatlevik, 2018) shows that collegial collaboration among teachers is positively associated with using technologies in their teaching practice. However, it is better if there is a continuous program that develops teacher use of technologies in learning practice to impact teacher self-efficacy positively. This statement is in line with a study (Dolighan &

Owen, 2021) that shows teacher efficacy improved and stayed high over the long-term versus just having a one-day workshop. Another study concludes that TPK should be included in regular mandated teacher professional development programs to provide teachers with continuous online teaching capabilities (Ma, Chutiyami, Zhang, & Nicoll, 2021).

Self-Efficacy on Technological Content Knowledge (TCK)

There is a content area and pedagogical area in teaching. As teachers need to understand how to use technology in a pedagogical area, teachers should also know how technology can be used in content areas, known as technological content knowledge. Technological content knowledge in this study refers to teachers' knowledge of how student understanding and practice of concepts in a certain content area might be transformed by technology. (Schmidt, Baran, Thompson, Mishra, Koehler, & Shin, 2009). It is mentioned before, teachers' self-efficacy on technological pedagogical knowledge is in a good category, so with technological content knowledge. Teachers believe that they know about technologies that can use for understanding and doing biology. Teachers also believe that online resources are more accessible nowadays and make understanding biology easier. This belief is essential for developing teacher competence in teaching, as other studies said that a teacher who accesses knowledge and resources purposefully could refine and improve their instructional planning. Teachers who use technologies in their content area develop new skills, plan more dynamic learning activities, and actively find answers to students' questions (Perrault, 2007). However, a troubling result from a previous study shows that although there is an increase in seeking online resources, teachers usually limit their information-seeking primarily within search engines and do not take full advantage of educational-related digital libraries, online databases, or other resources (Hiong & Osman, 2013). So, hopefully, this self-efficacy can be a force for a teacher to interact with a wide variant or spectrum of online resources so that it will eventually enrich their content knowledge, technological knowledge, and technological content knowledge.

Self-Efficacy on Technological Pedagogical Content Knowledge (TPACK)

The covid-19 pandemic crisis has forced sudden change and challenges requiring a teacher to adapt to distance learning. Distance learning will work well if supported by the teacher's knowledge of technology and the teacher's ability to integrate technology into his learning (Gurley, 2018). Therefore, teacher's technological pedagogical content knowledge is crucial. TPACK underlies the need for a teacher to understand in-depth knowledge of content, determine the right instruction actions, utilize the right technology in planning active learning, and integrate these three aspects in learning (Koehler & Mishra, 2006). Teachers who utilize the TPACK framework can analyze their needs to develop the ability to plan and carry out learning (Rochintaniawati, Riandi, Kindy, & Rukayadi, 2019), including practical work as an integral part of biological learning.

TPACK in this study refers to the knowledge required by teachers for integrating technology into practical work in learning biology content while in distance learning.

Data show that teacher is in good self-efficacy on integrating technology while teaching biology through doing practical work. Teachers believe that they can successfully practice their TPACK well despite being in distance learning. Previous studies (Kartimi, Gloria, & Anugrah, 2021) report that teachers respond positively to online distance learning. Another study from a school in the Philippines shows that teachers have high TPACK self-efficacy and continuance intention on online distance learning (Cahapay, 2021). This result shows a positive sign toward successful learning because teachers' positive attitude towards using technology for online distance learning is likely to positively influence the way teachers teach and students' learning experiences (Govender & Govender, 2009).

Through this study, we know that teachers confidently could design a lesson that appropriately combines biology as content, technologies, and practical work during distance learning. Teachers start by choosing biological content that has the potential to be studied through practical work. Then teachers choose a form of practical work that allows being done by considering students' conditions, such as materials, tools, etc. Lastly, teachers choose what technology can facilitate designed practical work. These lessons designed by teachers are the result of the interaction of three basic knowledge that built TPACK. After undergoing distance learning, teachers realize the importance of integrating or utilizing technology in practical work on learning biology. They say that the technology could be a bridge to reduce learning losses that occur due to pandemics. So that students still get hands-on skills through online practical work. This statement is in line with research that says that this pandemic potentially accelerate the rate of teacher technology engagement, and student have learned useful skillsets (Winter, Costello, O'Brien, & Hickey, 2021).

Teachers need to feel capable of successfully implementing reform strategies in their classrooms, and one way to accomplish this goal is to create and promote adequate professional training. Studies show that the success of online teaching can be affected by institutional support, which provides workshops or another program (Howard, Curwood, & McGraw, 2018). Online teaching pedagogies should be incorporated into regular mandatory teacher professional development programs to provide teachers with ongoing skills in online teaching.

Numerous studies have shown positive relationships between teachers' self-efficacy and various outcomes considered indicators of teacher performance (Sharp, Brandt, Tuft, & Jay, 2016). This study shows that teachers rate themselves high toward their TPACK. However, data found that 12 out of 42 teachers did not conduct practical work during distance learning despite being good in self-efficacy. It is a fascinating finding. Future studies should be conducted with actual measurements and observations to determine if teachers' self-efficacy aligned with the reality of teachers' TPACK.

Discussion on Teachers' TPACK Self-Efficacy

The following is the discussion of a result as well as the implications of this study. The result of the study showed that Biology teachers are in good self-efficacy on their TPACK. It can be seen consistent in seven TPACK components.

The good self-efficacy founded in this study is comparable with other related studies conducted before in the context of online distance learning. A researcher in the Philippines assesses the TPK self-efficacy and continuance intention of teachers in remote education amid the COVID-19 crisis (Cahapay, 2021). Meanwhile, a researcher in Java, Indonesia, identifies chemistry teachers' TPACK and attitude in online distance learning during the COVID-19 outbreak (Kartimi, Gloria, & Anugrah, 2021). Those studies explore self-efficacy in the context of online learning in a classroom setting. However, this study explores self-efficacy in the context of learning through practical work.

A related study in this theme suggests that understanding teachers' TPACK self-efficacy can be a practical approach to identifying readiness to teach online distance learning. The result of this study adds a piece of knowledge that self-efficacy plays a role in the development of teacher competence, including when teachers are faced with sudden changes such as a pandemic. Previous researchers from Germany consider teachers' self-efficacy as a powerful resource for teachers obliged to adapt to online teaching during COVID-19 school closures (König, Jäger-Biela, & Glutsch, 2020). This result may be used as a basis to develop a professional program to improve teachers' TPACK.

CONCLUSION

This study aimed to explore Biology teacher self-efficacy on their TPACK in practical work during distance learning amid the COVID-19 crisis. The result shows that Biology teachers have a good self-efficacy on their TPACK. This result indicates sustained integration of technology in learning even after the covid-19 crisis, for example, when blended learning is in the future. However, despite good self-efficacy, not all teachers did practical work during distance learning. Therefore this finding needs to be addressed quickly and precisely. On the other hand, it is still challenging to identify Biology teachers' TPACK in action during online-based practical work. So, further research is needed on how Biology teachers apply their TPACK in conducting online learning.

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