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EVALUATION OF ONLINE BIOLOGY LEARNING IN INDONESIA BASED ON THE TECHNOLOGY ACCEPTANCE MODEL (TAM)

Evaluasi Pembelajaran Biologi Daring di Indonesia berdasarkan Technology Acceptance Model (TAM)

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Abstract

This research aims to evaluate online biology learning in Indonesia based on the technology acceptance model (TAM), which includes ease, usefulness, attitude, and intention to use technology. This research was interpreted in descriptive quantitative using a survey method with the research sample of biology teachers and high school students throughout Indonesia who had done online biology learning. The results show that biology teachers and high school students agree that online biology learning with the Learning Management System using Google Classroom, social media using WhatsApp, and video conference using Zoom Meetings is easy to use and has beneficial functions for users in online learning. Online biology learning using Google Classroom, WhatsApp, and Zoom meetings is acceptable and suitable as software for learning biology.
Keywords: biology lesson, evaluation, online learning, technology acceptance model.

Abstrak

Tujuan penelitian ini adalah untuk mengevaluasi pembelajaran biologi secara daring di Indonesia berdasarkan TAM yaitu model penerimaan teknologi meliputi kemudahan, kemanfaatan, sikap, dan kecenderungan penggunaan teknologi. Penelitian ini bersifat deskriptif kuantitatif menggunakan metode survei dengan sampel penelitian guru biologi dan siswa SMA/sederajat di seluruh Indonesia yang telah belajar biologi secara daring. Hasil penelitian menunjukkan bahwa guru biologi dan siswa SMA/sederajat setuju pembelajaran biologi daring mudah dilakukan menggunakan LMS berupa penggunaan Google Classroom, media sosial berupa penggunaan WhatsApp, maupun video conference berupa Zoom Meetings karena memiliki fungsi yang menguntungkan bagi guru dan siswa, dapat diterima dengan baik, dan sesuai sebagai sarana pembelajaran biologi.
Kata Kunci: daring, evaluasi, pembelajaran biologi, technology acceptance model.

INTRODUCTION

Learning is individual self-improvement into a good attitude or knowledge caused by interaction with the environment. Learning needs interaction between student and teacher. The student plays the role of the one who studies, while the teacher plays the role of a facilitator who accompanies the student to reach the learning objectives. It is a learning process (Jayawardana, 2017; Lisman et al., 2021). In the learning process, a teacher has to create a learning method to motivate students to learn more actively through various learning sources. It could be conducted by providing appropriate learning tools for the situation and conditions in the class so every student could interact well with the teachers and other students.

The learning process will be enjoyable if the learning tools can simplify the teacher's delivery the information and knowledge to students; both could increase the students learning results (Triana & Yuliani, 2018). Learning tools, also known as learning media, are used for distributing learning materials as the teacher could get students' attention, interests, thoughts, and feelings while studying. Teachers and students could use learning media to reach the learning objectives they want (Surata et al., 2020).

In biology learning, to reach the learning objectives must have several points called nature and characteristics of biology learning. Nature and characteristics of biology learning include scientific processes, knowledge, attitudes, and technology (Sudarisman, 2015).

Scientific knowledge and processes mean the biology learning process needs intellectual skills, manual, and

social or science process skills. These skills are observing, classifying, measuring, calculating, predicting, communicating, asking, inferring, controlling variables, formulating problems, composing hypotheses, making research design, and studying the use of objects in the form of creature life and environment. Skills in the scientific process stimulate learning awareness and high-order thinking skills. A scientific attitude has the attitude of a scientist in their research; honest, thorough, objective, patient, tenacious, respecting other opinions, etc. Whereas technology is the application to solve problems in daily life (Hadiyati et al., 2019; Sudarisman, 2015).

Learning media used in biology learning could be animal or plants preservation, torsos, pictures, videos, PowerPoint, interactive multimedia, and other goods from the internet (Surata et al., 2020; Tondang & Arwita, 2020). The development of technology provides diverse information through internet access. Technology that has been developing also supports a learning environment to be more creative, innovative, and fun. Students could access learning sources such as literature through thrifty and comprehensive information service providers. Teachers can also develop learning by exchanging ideas, sharing information, and doing the virtual simulation with animation to complete the learning activity (Tondang & Arwita, 2020).

An application or platform to facilitate online learning is called Learning Management System (LMS). LMS is the learning media for online learning activities (Alzahrani & Seth, 2021). A teacher could share knowledge with students who join the class through LMS. Besides, students can get an education anywhere they are (Alzahrani & Seth, 2021; Reid, 2019). Some LMS require specific programming skills and database management knowledge (Kraleva et al., 2019). Typical LMS used by the community are Schoology, Edmodo, and Google Classroom. Schoology is one of the LMS that can be accessed for free with many features like attendance, class discussion, quiz, evaluation, and task submission. It is the same as Google Classroom, this platform developed by Google can be accessed for free by schools, non-profit organizations, and anyone's account in Google. Whereas Edmodo is a free learning application where the teacher can provide and manage online classes wherever and whenever easily because it has a similar appearance to Facebook (Leny Dhianti, 2021).

The advantage of using LMS in online learning is the availability of complete learning features so that the teacher can easily manage the class. The appearance of LMS is also attractive as the student are expected to have more interest in learning. While the disadvantage of using LMS is the stability of the internet connection is more likely to affect access to the app (Leny Dhianti, 2021; Surya Listya Yudhana & Andhyka Kusuma, 2021).

Another application that can help online learning is social media. Some social media used as online learning media are YouTube, WhatsApp, Facebook, Instagram, etc. The advantage of using social media as an application for online learning is that students can better understand material delivered by the teacher through interactive impressions that can be accessed via social media like YouTube and Instagram. Students are also more active in expressing their opinion by commenting on each social media account that uploaded the task result. Students can also make their friends' tasks as a reference for their task (Br Halawa, 2021). Meanwhile, the disadvantage of using social media is students and teachers can use the application only to send messages, photos, and documents which causes a lack of literacy (Sari et al., 2021).

Video conferencing applications can be used to support online learning too. Video conferencing applications that are broadly utilized are Zoom Meeting and Google Meet. Video conferencing has advantages that allow students and teachers to have the meeting virtually face to face. Learning with this application is called synchronous learning (Aminah et al., 2021). Deficiency in using video conferencing in the network connection could influence the smoothness of the learning activity video (Oktaviani et al., 2018).

The covid-19 pandemic urges a change in society either education. One of the changes is the implementation of online learning (Dewi, 2020). Online learning is learning without seeing face-to-face directly using a platform that helps the learning process done from a distance (Ika & Sri, 2020). Online learning aims to provide a good, massive, and open learning service to gain more people to keep learning. Online learning requires supporting devices like smartphones, laptops, computers, and tablets to access information anytime and anywhere (Sadikin & Hamidah, 2020).

Online learning has advantages, such as students can study and teachers can teach whenever and wherever with no space limit. A study shows the advantages and disadvantages of online learning based on perceptions of high school teachers and students in Jakarta that online learning makes teachers and students more relaxed in carrying out the learning process because there is no limit in space and time and simplifies students on their

tasks. Students and teachers also have more time to rest (Supriyatin & Asih, 2021).

Online learning is a challenge for students as well as teachers. Deficiency in online learning from a teacher's point of view is the lack of ability of the teacher to choose the proper learning method so that they couldn't achieve the learning objectives well. Teachers also find it hard to maintain students' activity during the class. Students are sued for developing their self-potential, although the learning progress has done virtually (Supriyatin & Asih, 2021; Suriadi et al., 2021). This virtual class causes a lack of interactions between teachers and students, and between students that worsen the character of every student.

TAM (Technology Acceptance Model) is an approach that describes human's behavior in accepting new technology (Holden & Karsh, 2010). TAM could be interpreted as the willingness of using technology observed in utilizing technology to have the job done (Yucel et al., 2013).

TAM is suitable for learning the reception of technology in a system. A system would be accepted by its user according to TAM noticing its ease and usability. It is also related to the user's attitude toward a system that causes a behavior or habit for keep using the system tested (Vuković et al., 2019).

The TAM developed by Venkatesh & Davis (1996) is the research design used. This model has five construction, there are Perceived Usefulness, Perceived Ease of Use, Attitude toward Using, Behavioral Intention to Use, and Actual Use with the following explanation:

1. Perceived Ease of Use (PEOU)

PEOU is a perception of the convenient use of technology. It is declared if somebody believes the technology could be used and understood easily.

2. Perceived Usefulness (PU)

PU is a perception of the benefit of using technology. It is declared a condition when someone believes technology will benefit the user.

3. Attitude toward Using (ATU)

ATU is an attitude toward technology. This attitude could be a denial or reception response after using a technology.

4. Behavioral Intention to Use (BITU)

BITU is a user's willingness to keep using technology. It is shown with their attention to technology whether it is a motivation for permanent use and asking others to do the same (Lai, 2017).

The research problem in this study is: How do teachers and students accept the technology in online biology learning during the Covid-19 pandemic? Therefore, this research aims to evaluate online biology learning in Indonesia with TAM.

METHOD

This research included descriptive quantitative survey research. Categorized as survey research because it is conducted to find out and describe the behavior, opinions, habits, or characteristics of a group or population (Santosa, 2021; Suriyanti, 2021). A survey is a research method from data sources or information from respondents with a questionnaire or questionnaire as an instrument. The study sample in this research is a group or population: biology teachers and high school students who had done online biology learning.

Technology acceptance in online learning for biology can be determined through the questionnaire. A questionnaire is a method to collect data by giving a set of questions to a respondent in large numbers over a wide area.

The research instrument used is a questionnaire with biology teachers and students in high schools throughout Indonesia as respondents. The questionnaire was then spread online with Google Forms on various social media platforms. WhatsApp, Telegram, Twitter, and Facebook to get respondents. Then the results of the questionnaire by respondents were analyzed by descriptive quantitative on each TAM aspect mentioned before. Data obtained is teacher and student responses to the platform usage during online biology learning.

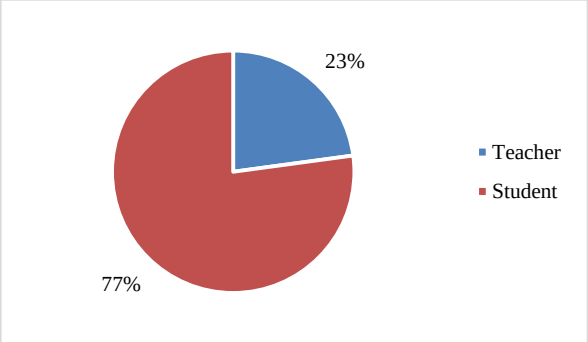

Figure 1. Respondent profile

Figure 1 shows data from the respondent profile. Based on the diagram in Figure 1, it can be known that the distribution of respondents who filled in the questionnaire consists of 77% high school students and 23% biology teachers in Indonesia.

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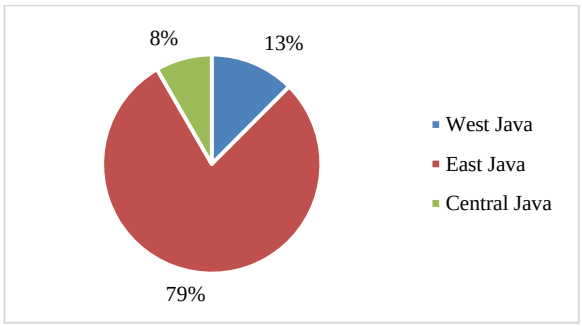

Figure 2. Respondent profile: domicile of biology teacher

The diagram in Figure 2 shows the teacher area who filled in the questionnaire. 79% of teachers live in East Java, while 13% and the other 8% are in West Java and Central Java.

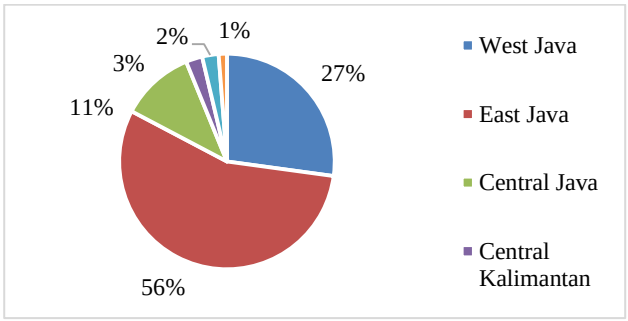

Figure 3. Respondent profile: domicile of high school students who had online biology learning

The diagram in Figure 3 shows the distribution of high school students who responded to the questionnaire. 56% of students are domiciled in East Java, 27% are domiciled in West Java, 11% are domiciled in Central Java, and the others are from Central Kalimantan, Jakarta, and Lampung. Data obtained from the total respondents, which is 105 people are valid and reliable.

The questionnaire used has 24 items of questions of 4 TAM aspects, including PEOU, PU, ATU, and BITU. The profile of the instrument used in this research is as follows:

Table 1. Profile of the instrument

ASPECT	INDICATOR	ITEM NUMBER
Perceived Ease of Use (PEOU)	Easy to use in online biology learning without a user guide.	1, 2
	Easy to communicate during online biology learning.	3, 4, 5
	Easy to learn topics or biological theories through online learning.	6
Perceived Usefulness (PU)	Could be used for communicating and sharing relevant information during online biology learning.	7, 10
	Could be used for controlling or evaluating the class during online biology learning.	8
	Could be used for creating a creative and innovative online biology learning.	9, 11, 12
Attitude toward Using (ATU)	Give positive impact in technology during online biology learning.	13, 16. 18
	Increase the teamwork between students to have a symbolic thinking and understanding imaginative things through online biology learning.	14
	Practice science process skills (observing, classifying, communicating, asking, concluding, making hypothesis, and doing experiment) virtually.	15, 17
Behavioral Intention to Use (BITU)	Could be used for online biology learning in the future because it improves students and teachers' skills.	19, 21, 23, 24
	Could be used as online biology learning media in the future to develop learning awareness and skills in high order thinking.	20, 22

Descriptive statistical methods analyze the results in the evaluation of online biology learning. Data from the questionnaire response will then be processed, analyzed, and interpreted.

RESULT AND DISCUSSION

The research was done with 105 respondents consisting of biology teachers and high school students using a questionnaire to evaluate online biology learning in Indonesia based on TAM containing five questions on each aspect. Data obtained from perceptions of biology teachers and students for online biology learning in Indonesia with different platforms based on TAM.

Based on three distributed questionnaires, various platforms are used for online biology learning. Platforms for online biology learning will be described in Figure 4.

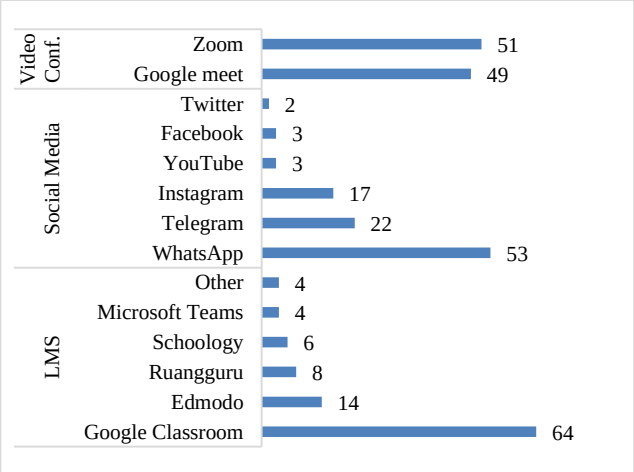

Figure 4 Platforms used during online biology learning in Indonesia (%)

Based on the data shown in Figure 4, 64% of 38 respondents used Google Classroom as their LMS for online biology learning. Respondents who filled in the questionnaire about social media use WhatsApp as a social media for online biology learning. Of the 37 respondents, 53% of them use WhatsApp. Meanwhile, for video conferencing, they only use two applications: Google Meet and Zoom. Of the 30 respondents who have filled in the data in the questionnaire, 51% use Zoom Meeting as a video conferencing application for online biology learning.

a. Result of Technology Acceptance based on Perceived Ease of Use (PEOU)

The result of technology acceptance based on the perceived ease of using Google Classroom, WhatsApp, and Zoom Meeting is presented in the following data.

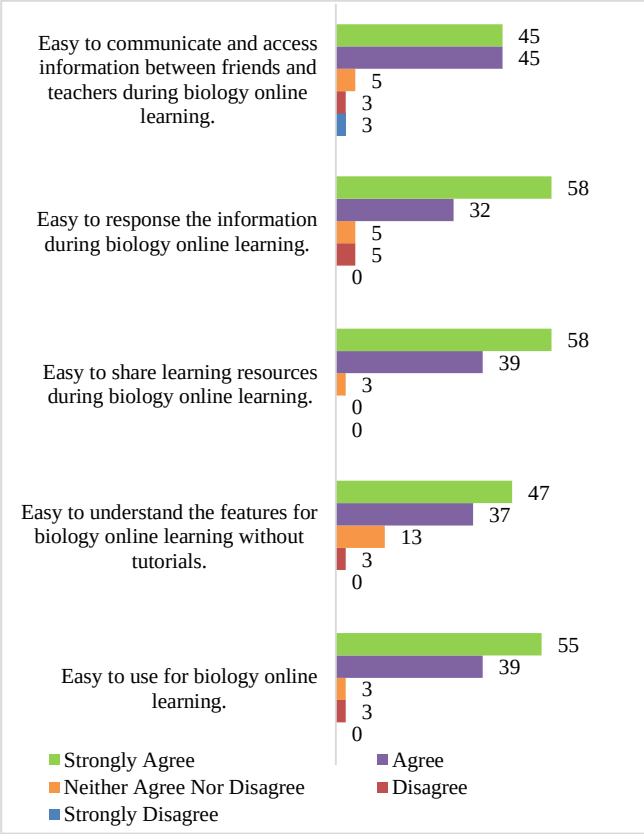

Figure 5. Technology acceptance: teacher and student perceived ease of using Google Classroom (%).

Based on the data in Figure 5, it is known that most teachers and students in Indonesia strongly agree with the easefulness of LMS, Google Classroom, as a online biology learning platform. From the data that has been obtained, it could be declared that teachers and students feel Google Classroom is easy-to-use for online biology learning; the features can be used without a tutorial, easy to share learning sources, give a response, communicate, and access information between friends as well as teachers during online biology learning. Research shows that Google Classroom can make ease interaction during online learning between teachers and students (Ifadah & Muji, 2022; Suhada et al., 2020). Google Classroom in online biology learning is convenient on a few topics such as biological scope, viruses, diversity, animals and plant tissue, human movement system, ecosystems, and genetics.

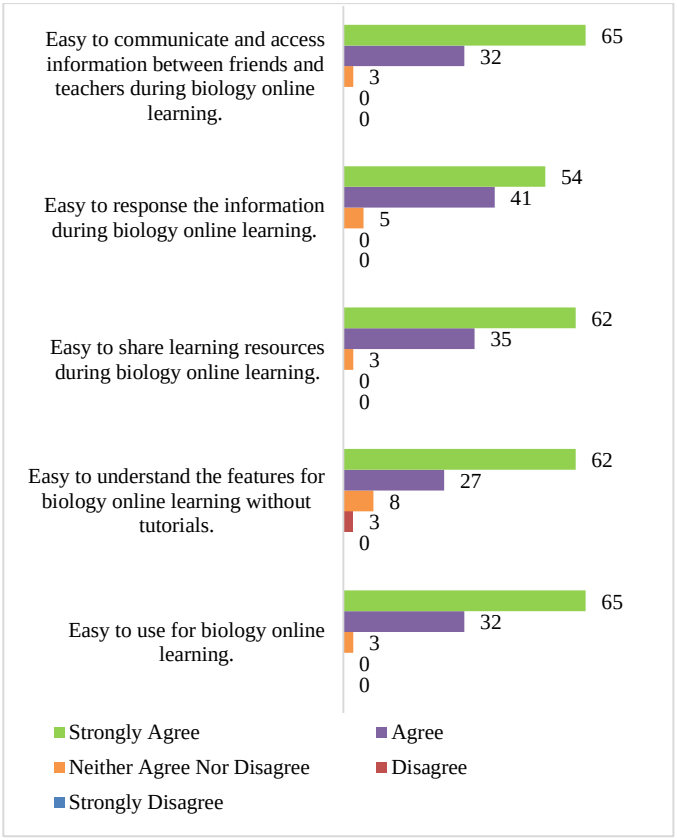

Figure 6. Technology acceptance: teacher and student perceived ease of using WhatsApp (%).

Based on the data shown in Figure 6, most respondents strongly agree that social media WhatsApp is easy to use for online biology learning. It could be declared that WhatsApp is easy to use for online biology learning because the features can be used without a tutorial, easy to share learning sources, respond to information, and communicate during online biology learning. WhatsApp can be used as a medium to facilitate (Daheri et al., 2020; Ifadah & Muji, 2022). WhatsApp is suitable for biology topics that need an explanation of a cycle, like the circulatory system, digestive, growth and development, and issues that require creativity, such as making an article about drugs and food substances.

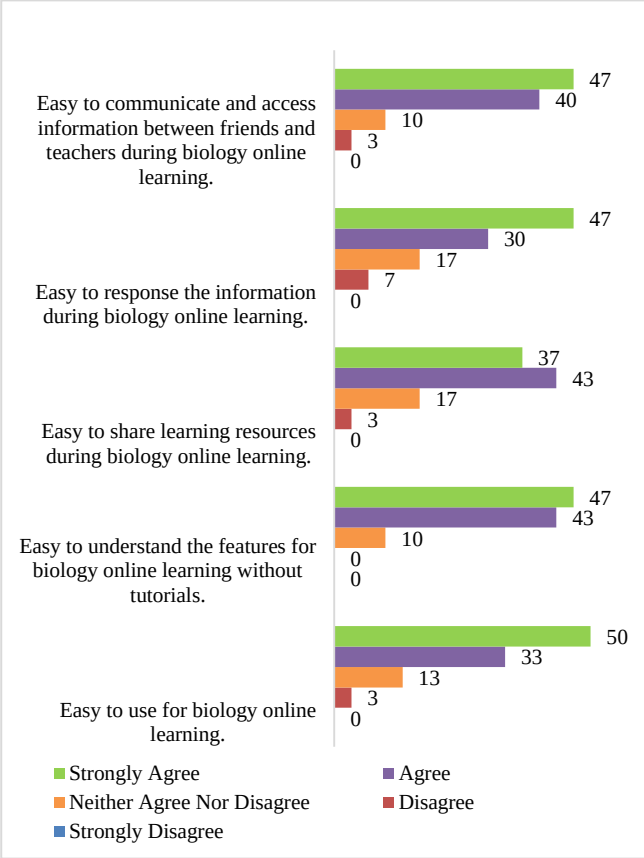

Figure 7. Technology acceptance: teacher and student perceived of using Zoom Meeting (%).

Based on the data presented in Figure 7, most respondents strongly agree that using Zoom Meetings video conferencing for online biology learning is easy. So that could be explained that teachers and students strongly agree that Zoom Meetings is easy to use; its features are easy to understand, share, communicate, and respond to information during online biology learning. This result is in accordance with the research that has been done previously that Zoom Meetings give convenience in online learning because it is easy to access and operate (Haryeni Tamin, 2021). Respondents also stated that Zoom Meetings in online biology learning could ease some topics like cells, metabolism, enzymes, and blood.

b. Result of Technology Acceptance based on Perceived Usefulness (PU)

The result of technology acceptance based on the perceived usefulness of Google Classroom, WhatsApp and Zoom Meeting is presented in the following data.

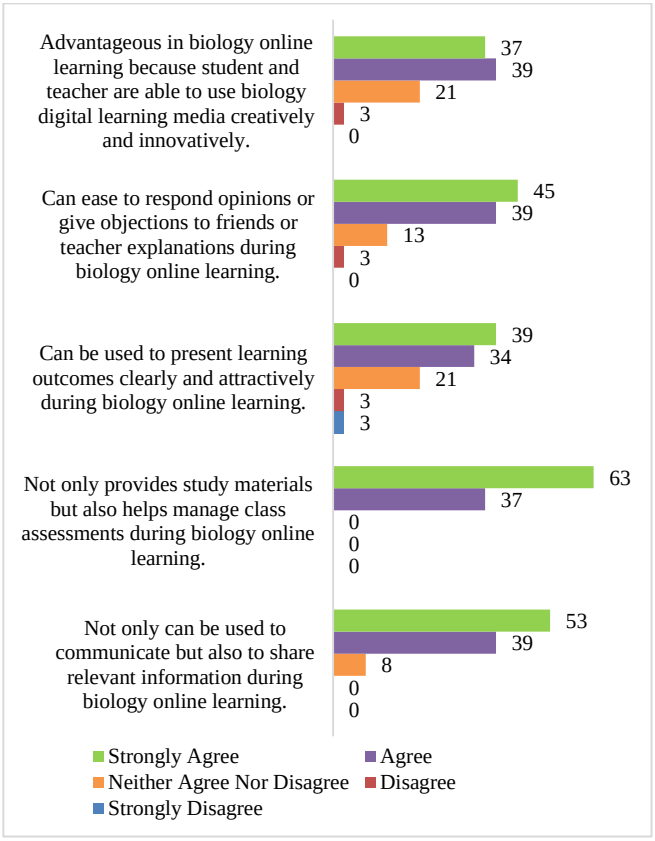

Figure 8. Technology acceptance: teacher and student perceived usefulness of Google Classroom (%).

Based on the data in Figure 8, it is shown that most respondents agree that using Google Classroom for online biology learning could benefit online biology learning. It can be explained based on the indicator that teachers and students agree that Google Classroom can be used to communicate and share relevant information, discuss, present, and assess assignments. It can also ease discussion and improve teachers and students to make creative and innovative biology digital learning media. Google Classroom also provides usefulness for teachers and students during online biology learning to manage classes and distribute questions and teaching materials (Suhada et al., 2020; Yanny, 2021) Respondents said those benefits are felt in topics like the diversity of life and plants and animal tissue.

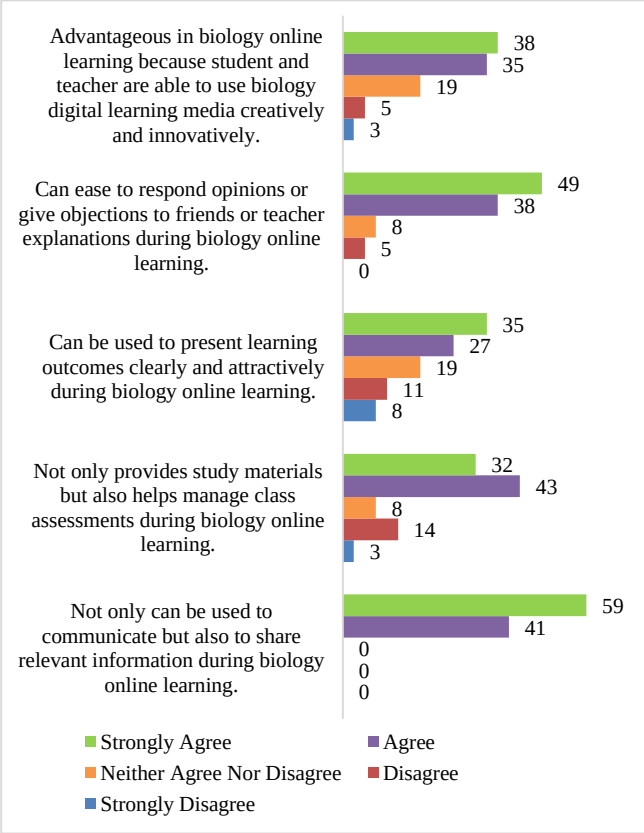

Figure 9. Technology acceptance: teacher and student perceived usefulness of WhatsApp (%).

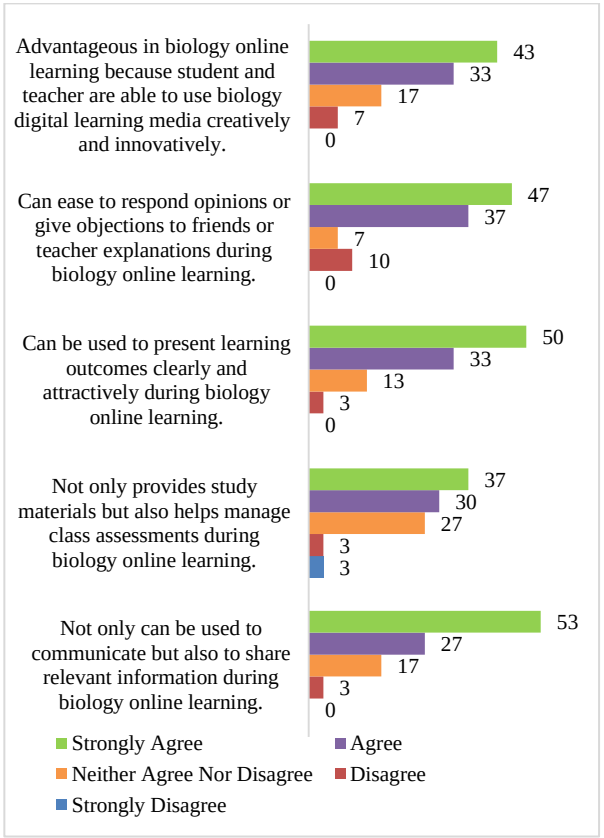

Figure 10. Technology acceptance: teacher and student perceived usefulness of Zoom Meetings (%).

Figure 9 presents the data of respondents who answered about social media WhatsApp. Most of them agreed with the usefulness *of WhatsApp* as the medium for online biology learning. The benefit of *WhatsApp* is that it can be used to communicate and share relevant information, and discuss, present, and evaluate students' assignments during online biology learning. Besides, teachers and students can use digital media creatively and innovatively related to other aspects related to biology. Online biology learning using WhatsApp gives usefulness for the user, which is teachers and student, to communicate and control the learning activity easily during online learning through existence WhatsApp Groups (Khasanah et al., 2021). The usefulness of using *WhatsApp* for online biology learning could be felt on topics like viruses, bacteria, fungi, and biotechnology.

Figure 10 shows questionnaire results about the perceived usefulness of using Zoom Meetings for video conferencing during online biology learning. Most teachers and high school students in Indonesia agree that online biology learning using Zoom Meetings is helpful to the user. It can be used to communicate and share learning materials, and discuss, present, and evaluate assignments during online biology learning. Zoom Meetings can stimulate students and teachers to be creative and innovative in online biology learning because of the existence of video and audio (Haryeni Tamin, 2021). Respondents think Zoom Meetings are appropriate for biological topics requiring many explanations and presentations like the food chain, biotechnology, translation, mutation, echinoderms, cells, and tissues.

c. **Result of Technology Acceptance based on Attitude Toward Using (ATU*)***

The result of technology acceptance based on the attitude toward using Google Classroom, WhatsApp and Zoom Meeting is presented in the following data.

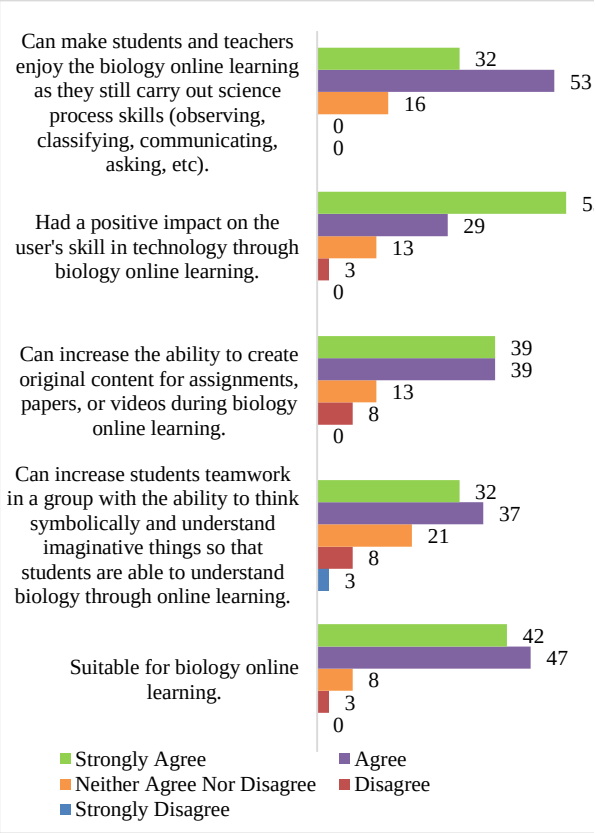

Figure 11. Technology acceptance: attitudes of teachers and students toward online biology learning using Google Classroom (%).

Based on the data presented in Figure 11, it is known that most of the respondents agree that Google Classroom is acceptable and suitable for use as a medium for online biology learning. Online biology learning using Google Classroom could increase teamwork between students in a group with the ability to think symbolically and understand imaginative things so that students could understand biology through online learning. Google Classroom also increases the ability to make original content through assignments, positively impacts the skill of using technology, and makes students and teachers enjoy online biology learning because they still do science process skills virtually. Respondents also explained the impact received from learning biology online using Google Classroom. It is more interesting because it could serve interesting, easy-to-use videos, is less time-consuming, and is flexible to give feedback on assignments, assessments, and evaluations. The student could submit their tasks efficiently and recall the previous materials easily, thus motivating the student to study. Google Classroom, as an LMS for online biology learning, is designed to have complete features to support teachers and students in their online learning (Leny Dhianti, 2021; Surya Listya Yudhana & Andhyka Kusuma, 2021). However, respondents also responded that online biology learning using Google Classroom is boring and slows the communication between teachers and students.

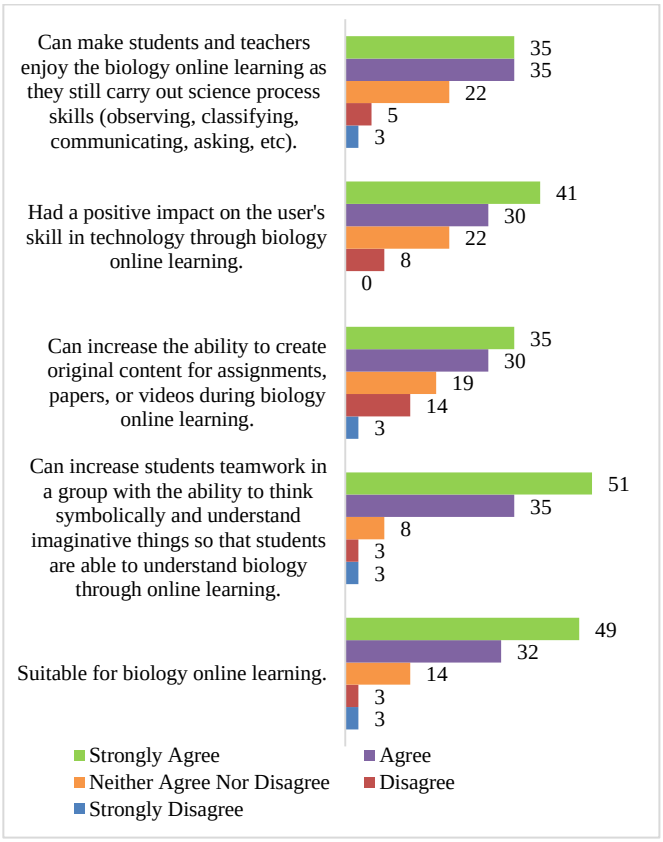

Figure 12. Technology acceptance: attitudes of teachers and students toward online biology learning using WhatsApp (%).

Based on data presented in Figure 12, respondents mostly agree that WhatsApp is suitable for online biology learning. Through WhatsApp, teachers and students could increase teamwork between students in a group with the ability to think symbolically, and understand imaginative things so that they know biology through online learning. WhatsApp also improves the user's ability to make original content through assignments, has a positive impact in using technology, and does science process skills virtually. Respondents explained their attitude toward using WhatsApp as a medium for online biology learning. It is suitable for a online biology learning medium because WhatsApp is an affordable platform. Communication becomes easier because students and teachers are both familiar with WhatsApp. Neither do students and teachers need to download other learning applications so that students are more motivated to learn, innovate, and be creative. But the negative impact of online biology learning using social media is learning feels boring and hard to

understand some biology materials because learning using WhatsApp is only conducted via chat. WhatsApp, as an application to support online biology learning, ease teacher to deliver the materials and motivate the student to study through online learning because of the accessible communication, but not compelling enough because the learning materials are only delivered in written (Br Halawa, 2021; Sari et al., 2021).

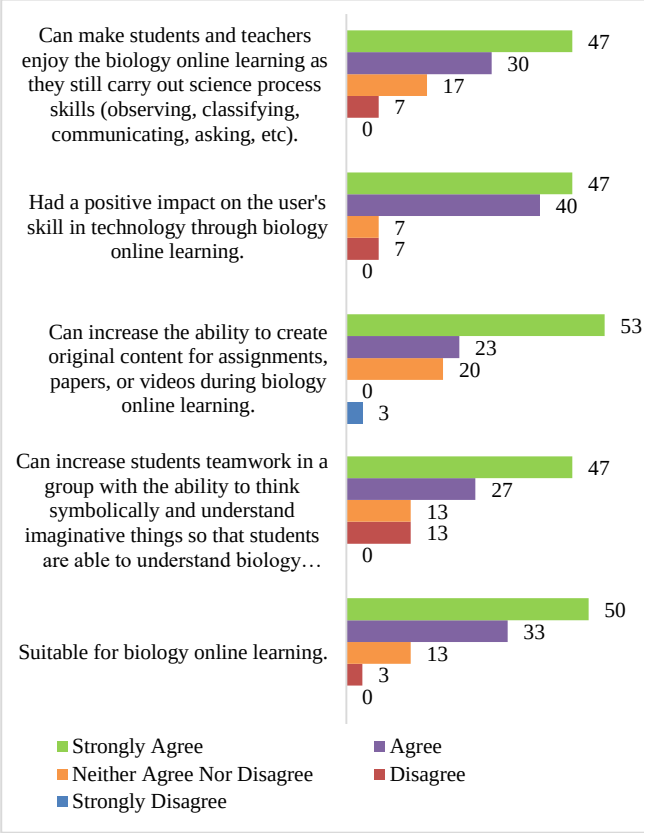

Figure 13. Technology acceptance: attitudes of teachers and students toward online biology learning using Zoom Meetings (%).

Based on Figure 13, most respondents strongly agree that Zoom Meetings are suitable for online biology learning. Online biology learning using Zoom Meetings could increase teamwork, think symbolically, and understand imaginative things so that students could understand biology through online education. Zoom Meetings motivate teachers and students to make original content through assignments, positively impact technology use, and practice science process skills virtually. Zoom Meetings provides visualization of biological theories. The explanations also become clearer via share screens or direct answers from the teacher so that online biology learning becomes more understandable. Students can discuss virtually when teaching is in progress by asking or responding to the teacher or friend's explanation, so the information obtained becomes more detailed. Online biology learning using Zoom Meetings could maximize teachers to deliver the materials virtually through real-time communications or synchronous (Aminah et al., 2021).

d. Result of Technology Acceptance based on Behavioral Intention to Use (BITU)

The result of technology acceptance based on the behavioral intention of using Google Classroom, WhatsApp and Zoom Meeting is presented in the following data.

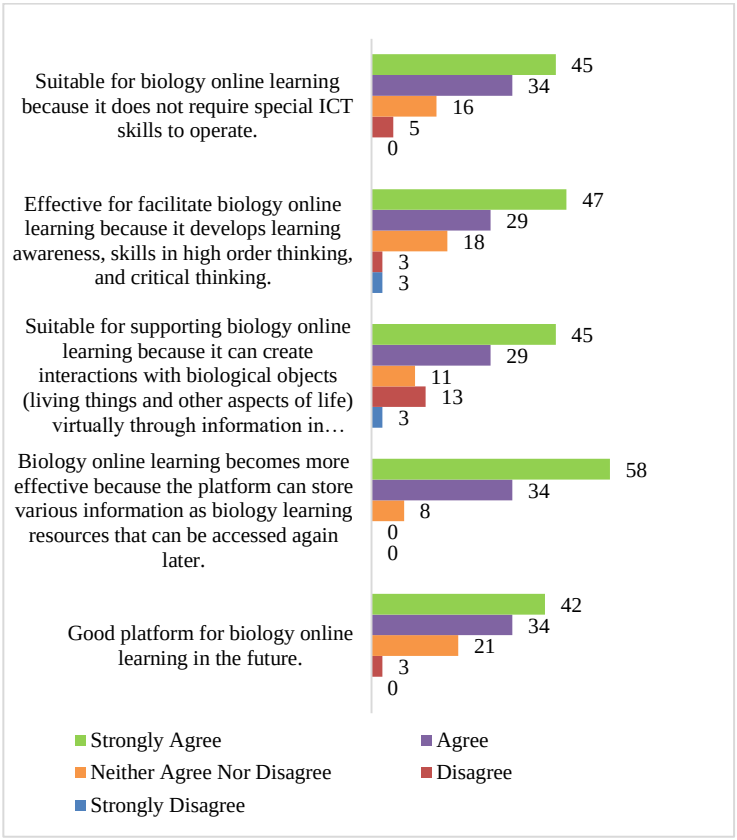

Figure 14. Technology acceptance: teacher and student to behavioral intention to use Google Classroom for online biology learning (%).

Based on the data in Figure 14, most respondents agree to use Google Classroom as a medium for online biology learning in the future. Google Classroom can be used as online learning media for biology in the next time because it is more effective and flexible in timing, distribution, and storage of learning materials (Suhada et al., 2020; Yanny, 2021). As the indicators written in the questionnaire, online biology learning will become more effective because Google Classroom could keep various information as a biology learning source that can be accessed again later, make interaction with biological objects virtually through information from digital media, provide good facilities to develop learning awareness and skills in high order thinking and critical thinking. Google

Classroom also does not require any special ICT skills to operate. According to the respondent's opinion, Google Classroom is suitable for almost every biological topic, such as metabolism, hormonal, circulatory, and excretory systems.

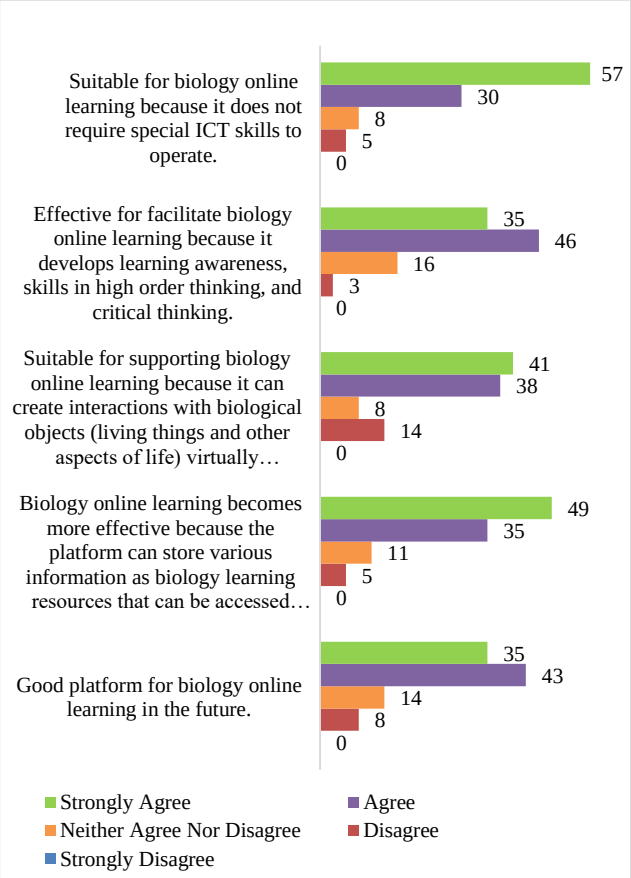

Figure 15. Technology acceptance: teacher and student behavioral intention to use WhatsApp for online biology learning (%).

In Figure 15, respondents agree to use WhatsApp as online biology learning media in the future. Online biology learning will become more effective because WhatsApp could save information as a biology learning source, interact with biological objects virtually, and provide an excellent facility to develop learning awareness and skills in high-order thinking and critical thinking. Besides, WhatsApp does not require any special ICT skills to operate. WhatsApp is effectively used as a medium for online biology learning because it gives room for teachers and students to develop their creativity and abilities in virtual learning (Daheri et al., 2020). Biological topics suitable for learning by WhatsApp are the topics that relate to the environment and daily life, such as the immune system, viruses, drugs, and evolution.

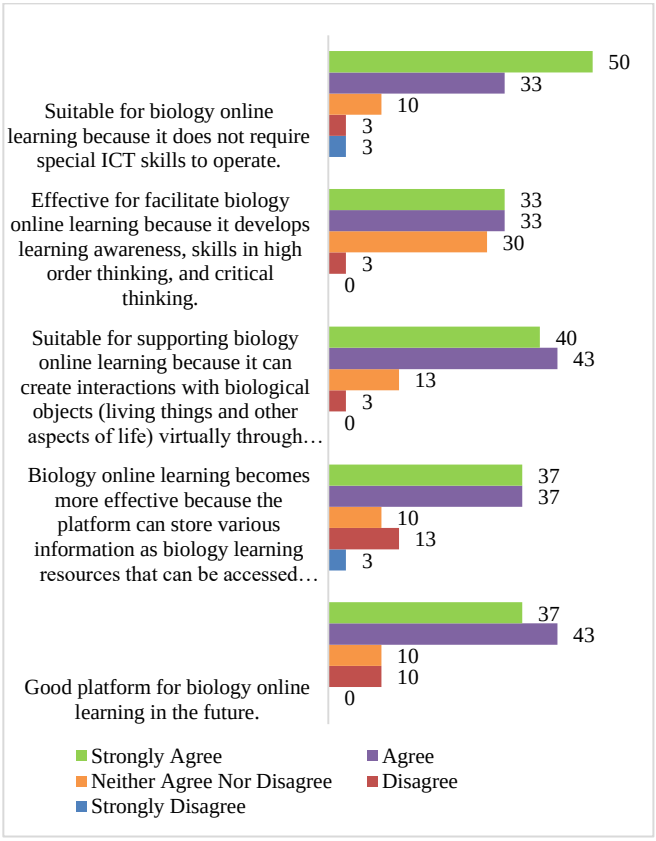

Figure 16. Technology acceptance: teacher and student behavioral intention to use Zoom Meetings for online biology learning (%).

Based on the data shown in Figure 16, most respondents agree to use Zoom Meetings as a future online biology learning platform. Zoom Meetings could save biology learning sources, interact with biological objects virtually through digital media, and provide an excellent facility to develop learning awareness and skills in high-order thinking and critical thinking. Besides, Zoom Meeting does not require any special ICT skills to operate. Online biology learning with Zoom Meetings is effective to be used as the following online learning media; the learning activity could be done properly because the teacher can show biological objects obviously through virtual learning (Akhirman, 2021; Haryeni Tamin, 2021; Hikmat et al., 2020). It is related to biological topics containing complex explanations and is suitable for learning through Zoom Meetings, such as mitosis and meiosis, enzymes and metabolism, digestive system, and circulatory system.

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CLOSING

Conclusion

The conclusion reached from this research is there is no difference between the perceptions of teachers and students who had done online biology learning on different platforms based on acceptance model technology (TAM). There are four aspects of TAM: easefulness, usefulness, attitude, and behavioral intention to use technology tested through questionnaires for teachers and students who had done online biology learning on different platforms. Based on the research results, respondents agree that all aspects of online biology learning using Google Classroom as LMS, WhatsApp as social media, and Zoom Meetings as a video conference application is easy-to-do and advantageous for users during online biology learning. It is also accepted and suitable for future online biology learning.

Suggestion

Other research related to online biology learning in Indonesia is needed. Studying the influence of the different platforms for online biology learning is also necessary to look at student learning outcomes.

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