

Student's Engagement on Online Biology Teaching and Learning: In the Perspective of Constructivism Theory

Masitah Abu Kassim*, Tengku Norbaya Tengku Azhar, Muhamad Rahimi
Che Hassan, Nur Syakireen Ishak, Norhafizah Mohd Zazi,
Khaniza Hasliza Abdul Khalil

Centre of Foundation Studies, Universiti Teknologi MARA, Cawangan Selangor,
Kampus Dengkil, 43800 Dengkil, Selangor, Malaysia
masitah3909@uitm.edu.my*

Received: 15 January 2024

Accepted: 25 February 2024

Date Published Online: 1 January 2024

Published: 1 January 2024

Abstract: Constructivism theory outlines that learning must be constructed through meaningful learning experience of the learners. Biology is the study of living things that comply with both theoretical and experimental. Since COVID-19 hit globally in 2020, education systems have been impacted and urged to make crucial changes. Online learning has become the main method of teaching and learning within the period. During endemic, academia must get back to face-to-face methods and leave behind the virtual one. This study highlighted the effectiveness of online learning in Biology towards student's engagement and learning experience. It measures the behavioural-cognitive engagement of the students towards their online learning experience and correlate it to their performances. A group of 114 foundation students who have enrolled in Biology courses were chosen to complete an engagement survey. A 5-point Likert scale has been used in this survey. It was reported that, students prefer to use online method of biology learning in certain circumstances but prefer face-to-face on daily session. The behavioural engagement of students reported the highest towards their effort to do exercise independently using the workbook with ($\bar{X}=3.89\pm0.75$) while prefer to have online consultation rather than face-to-face with ($\bar{X}=3.82\pm0.99$). The cognitive engagement level reported the highest means towards their connection of actual learning concept with the previous one with ($\bar{X}=4.02\pm0.66$). However, no significant correlation

was reported towards the behavioural and cognitive engagement of the students with students' performance since $P > 0.005$. The overall outcome highlight that, the effectiveness of online learning in terms of student's engagement for Biology could not entirely be determined by behavioural-cognitive engagement. Therefore, it is suggested that the hybrid method which corresponds to the constructivist-based to be considered next.

Keywords: *Biology, Constructivism, Face-to-face, Hybrid, Online*

1. INTRODUCTION

1.1 BACKGROUND OF STUDY

Many studies have been done to investigate the benefits of online learning and the effectiveness as well. Benefits and the effectiveness of online learning had a significant impact and superseded the difficulties that learners might have in order to achieve the learning goals (Hongsuchon et al., 2022; Xhaferi & Xhaferi, 2020). Diversification in teaching and learning approach exist as every student has their own unique learning nature with diverse personalities, learning wavelengths, and abilities (López, 2007). In every teaching and learning session, the educator aim is to ensure all the knowledge is well delivered while the learners perceive, process, store, and recall what they are attempting to learn most efficiently and effectively. The old traditional way on biology teaching such as lecturing “straight from the book “or memorizing concept from notes is a way behind the attractive learning approach. The passive way of learning in the classrooms where information is organized and presented to them by their teacher, limit their understanding on biology especially without dynamic interaction of thought processes and skills. As teaching and learning biology at the pre-university level has evolved in many ways over the past century, the content must be taught differently based on educational research with constructed principles of active learning. It's well known that the challenge for science-based courses like biology is to execute effective laboratory teaching and learning without actual hands-on activity.

The study by (Hongsuchon et al., 2022) they look at the impact of effectiveness and benefit of online learning in Knowledge Management. This study also used the theory of general self-efficacy. They suggested that the effectiveness of online learning had a significant impact on the benefits of online learning. It can be concluded that the more effective online learning was, the more benefits and positive outcomes the student experienced. Meanwhile, Hollister et al., (2022) in their study explores how a constructivist-based instructional design helped 32 adult learners learn in an online learning environment at a National University in Taiwan. Based on the results, a constructivist-based instructional approach seems promising to encourage adult learners to participate and engage in more collaborative, authentic and responsible learning.

Meanwhile, according to constructivism, learners construct knowledge rather than just passively take in information. Constructivist learning has risen as a subject in biology because it emphasises the five E's elements of Engage, Explore, Explain, Elaborate, and Evaluate about the phenomena, processes, or systems that surround them (Ahmad, 2009). Biology learning requires more than just the ability to explore and think critically that emphasise the importance of mastering skills such as critical, creative, communicative, and problem-solving thinking (Andyhapsari & Djukri, 2021). The merger of a new virtual platform for online teaching in Malaysia caused various issues for both educators and learners. The difficulty has come in the form of how effective online learning in this field in meeting pedagogical demands when compared to traditional delivery (Ramayah & Kumar, 2020).

1.2 OBJECTIVES

This study highlighted the effectiveness of hybrid learning in Biology and how this factors effect student engagement and learning experience. The specific objectives of this study are:

- To determine the aptness of online learning of Biology to constructivism theory.
- To indicate the association between online learning with student's behavioral and cognitive engagement.
- To determine the relationship between behavioral and cognitive engagement of online learning with students' performance in Biology.

2. METHODS

The cross-sectional survey is a quantitative study that has been done among 114 pre-university students from institution in Selangor. Ethical approval has been received from Research Ethics Committee of Universiti Teknologi Mara (UiTM) with reference to REC/02/2023(ST/MR/37). Sample size was calculated according to one mean of sample size. Students was accessed using designed survey instruments that divided into three parts; Part I (Demographic); Part II (Behavioral Engagement) and Part III (Cognitive Engagement). Behavioral engagement listed 7 items as in Table 2 while Cognitive engagement listed 6 items as in Table 3. In demographic part responded also require answering closed ended question to determine their score in biology exam and their preferences and experience of mode and platform in learning biology. Part II and III was designed with 5 Likert scale questionnaire from highly disagree, agree, neutral, disagree and highly disagree. Analysis has been done using SPSS software version 2.0 with descriptive and Pearson correlational study.

3. RESULTS AND DISCUSSION

3.1. DEMOGRAPHIC DATA

Survey has been done among 114 science students on their preference on online versus face-to-face version of teaching and learning Biology. Table 1 represent the descriptive data. Major respondents were female students with (n=93, 82.3%) and majority of them spent 31-minute to 1 hour for online study.

Characteristic	Variable	n	Frequency
Gender	Female	93	82.3
	Male	20	17.7
Time Spending for Online study	<30 minute	27	23.7
	31-minute -1 hour	46	40.4
	>1 hour	38	33.3
Duration of watching ASID BIOLOGY YOUTUBE CHANNEL	<30 minute	37	32.7
	31-minute -1 hour	45	39.8
	>1 hour	14	12.4
	Not watching	17	15

Table 1. Demographic Data of the Respondents

3.2 CHANGE OF STUDENT'S PREFERENCES IN CIRCUMSTANCES

According to Fig. 1, 2 and 3, it was reported that a preference towards mode of learning change drastically from face-to-face to online or mixed method during circumstances. In daily session such as lecture and tutorial (Fig. 1(a & b)), students prefer to have face-to-face rather than online but in certain condition they prefer to choose online class. However, for session that required hands-on like practical such as laboratory and assessment they prefer to have it face-to-face in both situation (Fig. 2, (a & b)). The students who adapted to online learning were able to customize their learning schedule and apply various strategies to adapt their environment. Even during post pandemic, it's still benefits students and makes learning process more convenient, accessible, and flexible (Lockee, 2021).

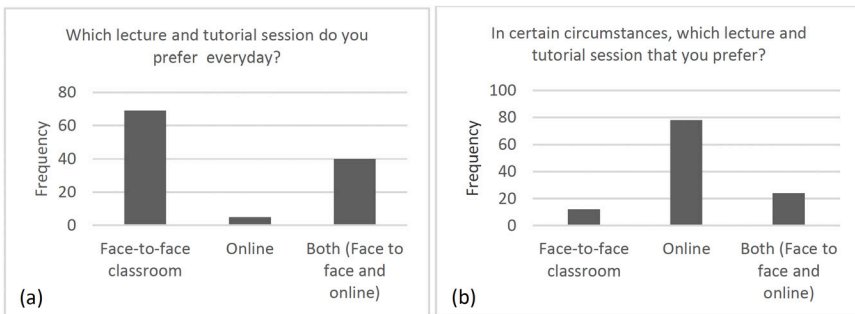
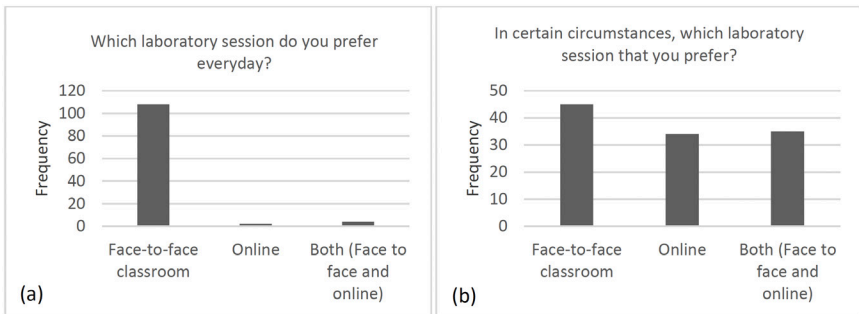


Fig. 1 (a) Which lecture, and tutorial session do you prefer every day? & (b) In certain circumstances, which lecture and tutorial session that you prefer?

It was supported in previous study by Bashir et al., (2021) that, sociodemographic factors such as the province; urban versus rural, and readiness of facilities like internet connectivity influences the preference of students towards shifting from face-to-face to online learning. In the case of this population, as the students is the permanent residence of the campus, the readiness of ICT facilities such as wireless internet connection, and various platform provided by universities technically support the online learning preference. However, for students that lacks these facilities at home, they voice their concern on the platforms and methods used by their

lecturers. As an example, some requested that lecturers should not use live applications such as Google Meet, Facebook Live and Zoom Meeting as these consumed a lot of their mobile data (Mathew & Chung, 2020). Poor internet connection is the major setback that captivated many students during COVID-19 pandemic. Although many of them indicated satisfaction with online learning, poor internet connection was a major factor that contributed to their lack of intention to continue using it in the future (Chung & Mathew, 2020). The emergence of various online platforms also considered an advantage in education systems as it integrates student-centred learning and technology (Haleem et al., 2022).



3.3 BEHAVIOURAL AND COGNITIVE ENGAGEMENT OF THE STUDENTS IN BIOLOGY TEACHING AND LEARNING

Behavioural engagement refers to active responses to learning activities and is indicated by participation, persistence, and/or positive conduct. Cognitive engagement includes mental effort in learning activities and is indicated by deep learning, self-regulation, and understanding (Hollister et al., 2022). To answer objective number two, students' engagement level has been surveyed using the instruments. Fig. 4 and Table 2 represent the behavioural engagement of the students to learn biology subject. The highest mean (3.89 ± 0.75) with the highest agreement (21.8%) were reported as most students were agreed to have a try to do their workbook as their

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independent effort to learn biology. Besides, they also prefer to have an online consultation if encountered with any problem related to subject rather than face-to-face. This was answering the objective number one that using an appropriate teaching material such as workbook or any online learning platform is suitable to encourage students to learn biology in any situation. According to Chung (2020), Google Classroom and YouTube videos was the most preferred online learning method during the COVID-19 pandemic. Based on the mean value (3.01 ± 0.84), however determine that students have less engage to the specific provided channel that offer to them in learning biology.

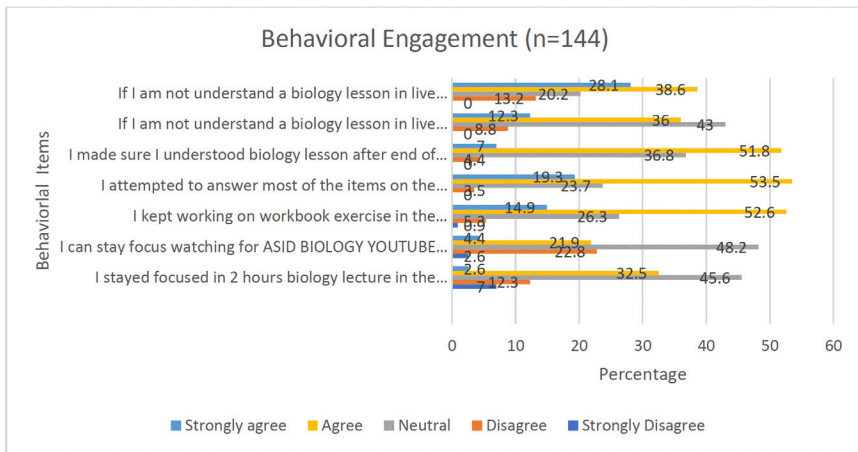


Fig. 3 Percentage of Behavioral Engagement of students

	Behavioural Engagement Items	Mean±SD
1	I stayed focused in 2 hours biology lecture in the classroom.	3.11±0.08
2	I can stay focus watching for ASID BIOLOGY YOUTUBE CHANNEL after 1 hour.	3.01±0.84
3	I kept working on workbook exercise in the classroom even it was hard.	3.75±0.80
4	I attempted to answer most of the items on the workbook.	3.89±0.75
5	I made sure I understood biology lesson after end of the live lecture in the classroom.	3.61±0.68
6	If I am not understanding a biology lesson in live classroom, I would prefer to consult with my lecture face to face.	3.52±0.82
7	If I am not understanding a biology lesson in live classroom, I would prefer to search for online information rather than face-to-face consultation.	3.82±0.99

Table 2. Behavioural Items and Means

Fig. 4 and Table 3 represent the cognitive engagement of the students to learn biology subject. The highest mean (4.02 ± 0.66) with the highest agreement (21.9%) determine that students always try to connect the information that they learn to the previous one. It thus indicates that, lectures should guide the students to continuously doing a recap once the lessons end. Based on study by Chung, Amir & Mathew (2020), the students prefer their lecturers to make their lessons more interesting by providing more online quiz such as Kahoot! as a way to recap their lessons. Students also disagree that doing an exercise in the workbook as a burden to them with 1.85 ± 0.89 mean score. This outcome was supported by previous study that online learning permits learners to work at a place and time that is appropriate with their learning needs (Kokoç, 2019). Based on study by Abdul Rahim & Choo (2021), students expressed their need for recording and live lectures including the past year questions to be made available online as a guide for them in their studies. Thus, it is answering through the behaviour of the students that requires more flexibility from online learning that aligns with the idea of ‘lifelong learning’. Moreover, students can avoid the hustle of having to go to the physical place or print out assignments as they are able to do it online in order to submit their assignments (Mathew & Chung, 2020). Furthermore, Yunus (2021) came with three main benefits of an online learning management system in Indonesian. It provides easy and communicative access, enhances collaborative learning, and facilitates the students to express their opinions as well.

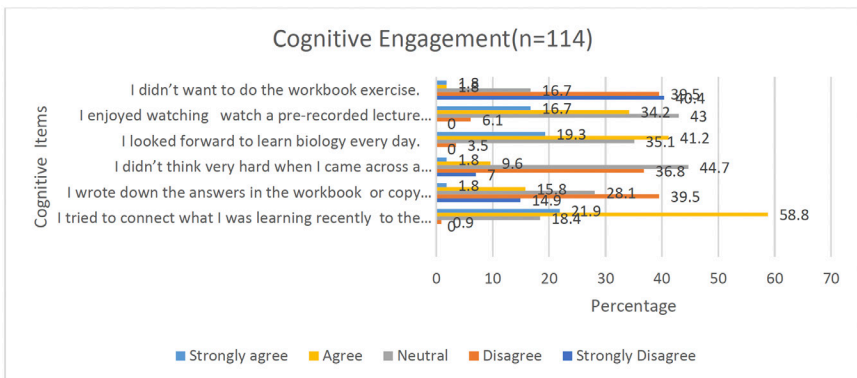


Fig. 4 Percentage of Cognitive Engagement of Students

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	Cognitive Engagement Item	Mean±SD
1	I tried to connect what I was learning recently to the biology concepts that I have learned before.	4.02±0.66
2	I wrote down the answers in the workbook or copy from notes and textbook without trying to understand them.	2.50±0.90
3	I didn't think very hard when I came across a challenging in biology topic.	2.60±0.82
4	I looked forward to learning biology every day.	3.77±0.80
5	I enjoyed watching watch a pre-recorded lecture video ASID Biology YouTube Channel.	3.61±0.84
6	I didn't want to do the workbook exercise.	1.85±0.89

Table 3. Cognitive Items and Means

3.4 RELATIONSHIP BETWEEN STUDENTS' PERFORMANCE AND ENGAGEMENT LEVEL

To answer objective number 3, the relationship between the level of student's engagement has been tested towards students' performance. Students' performance was measured using their score in their midterm test. The reported score was $\bar{X}=69.05\pm 12.76$ with the range of 37-94. In Fig. 5, no significant correlation with $P>0.005$ was reported between student's behavioural engagement with student's performance. However, some trends have been shown that students score was proportionate to the student's engagement level. In the usage of blended learning, both online and face-to-face, the use of this mixed learning environment led to a positive impact on reducing student dropout rates and improving their test scores (López-Pérez et al., 2011).

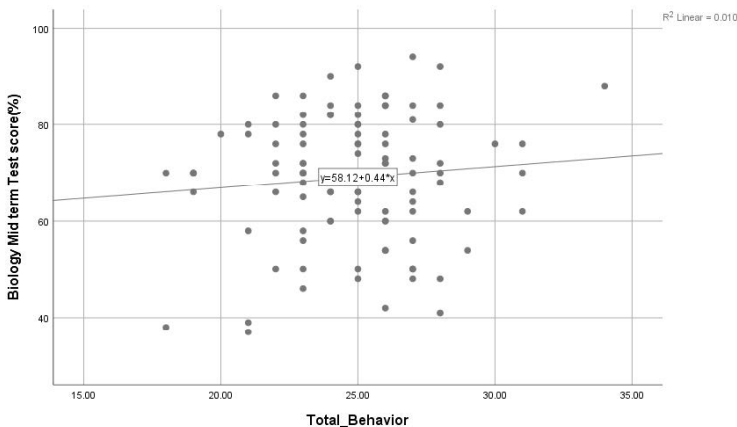


Fig. 5. Correlation between Behavioural Engagement with Students Performance

Moreover, mixed learning experiences can also strengthen students' understanding of the subject, improve and support their learning process (Lei, 2010). However, cognitive engagement (Fig. 6) shows a different trend which is negative correlation towards students' performance even though the correlation is non-significant. This indicates that the score of the students in the exam is not correlated to their cognitive engagement level. According to Jung et al., (2002), it is found that learning experiences in an online environment cause a positive attitude change concerning the use of the web for learning among the students, regardless of the type of interaction. Based on the study by Yustina et al., (2020), it shows that blended learning is able to increase creative thinking skills and quite effective compared to conventional learning in increasing creative thinking in biology learning. Blended learning can also maintain or increase access for large groups of students and result in better success rates (Dziuban et al., 2018).

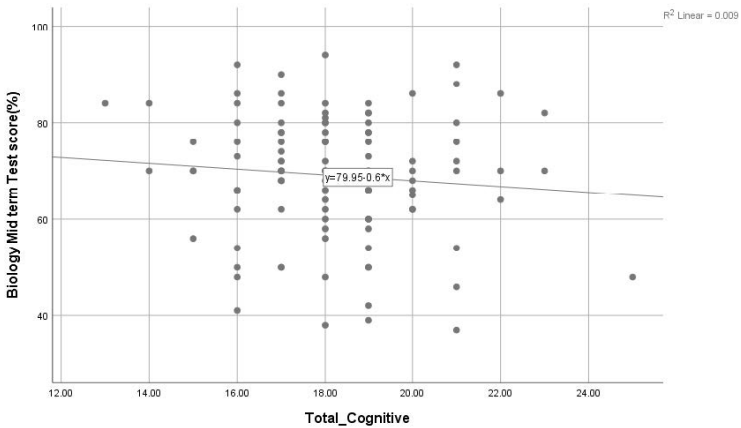


Fig.6. Correlation between Cognitive Engagement with Students Performance

4. CONCLUSION

The overall outcome highlight that, the used of choice of methods in teaching and learning is not the only factors that affect students' engagement in teaching and learning biology. By using an appropriate teaching material such as workbook or any online learning platform such as YouTube is suitable to encourage students to learn biology in any situation. Other than that, online learning permits learners to work at a place and time that is appropriate with their learning needs as well. Based on constructivism, the student is the learning focus of constructivist learning environments, and the instructors act as facilitators or guides. The students' knowledge is accumulated by themselves, and it is built on previous knowledge and experiences. So that, the mixed or hybrid learning environment led to a positive impact and able to increase creative thinking skills and quite effective compared to conventional learning in increasing creative thinking of biology learning. The effectiveness of online learning in terms of student's engagement for Biology could not entirely be determined by behavioural-cognitive engagement. Therefore, in the future, it is suggested that the hybrid method which corresponds to the constructivist-based blended learning environment (CBLE) to be considered in institutions.

5. CO-AUTHOR CONTRIBUTION

The authors affirmed that there is no conflict of interest in this article. All authors carried out the field work, prepared the introduction, research methodology, results and discussion, conclusion and overlook the writeup of the whole article.

6. ACKNOWLEDGEMENTS

Authors would like to thank Universiti Teknologi Mara (UiTM) Kampus Dengkil for supporting and opportunity to work on this project.

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