

Is There Constructivism in Online Interaction in Biology Teaching and Learning?

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Abstract

As the COVID-19 pandemic ends, online learning has grown in popularity among students and educators. It offers flexibility and affordability, opening new dimensions to teaching and learning. However, in some tough subjects, such as biology, which focuses on understanding the concept of life through practical effort, online learning appears to be rather difficult. This study overviewed constructivism in online learning of biology subject specifically in genetic study. The goal of this study is to determine the relationship between numerous elements, including learner-to-learner interactions, instructor-to-learner interactions, and learner-to-content interactions, and the efficacy of online learning. This quantitative study enrolled approximately 124 pre-university students from public institutions in Selangor. The instrument used is a 5 Likert-scale survey with four sections including Section A of demographic profile; Section B of learning in groups; section C of teachers as facilitators and section D on shared knowledge and authority. Overall, the highest mean value, ($\bar{x} = 4.2$) reported as learners consider that peer interaction in biology online learning activities is crucial for task completion and motivation support. The learner also believes that the simplicity of the online content is significant in online learning with $\bar{x} = 4.1$. There is also a significant association between learning in groups and teachers as facilitator ($r = .475^{**}$) and ($p = .000$). In addition, there is also a significant association between teachers as facilitator and shared knowledge & authority ($r = .687^{**}$) and ($p = .000$). Thus, to attract more students to

learn using an online platform, the usage of online learning in biology must be improved with specific improvements in forms of content, activity, and execution.

Keywords: Constructivism, Biology Learning, Online Learning, Genetic, Genetic Technology

Introduction

Background of Study

Jean Piaget, a Swiss psychologist, popularised constructivism as a fundamental concept in knowledge acquisition. This process is regarded as a dynamic process that the learner must lead through experience, discussion, and reflection (Andyhapsari, *et al.*, 2021; Honebein, 1996; Leidner and Jarvenpaa, 1995). 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 (Ahmed, 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 and Djukri, 2020). 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 and Kumar, 2020).

Statement of Problem

Online Distance Learning has been implemented for education around the world. However, its implementation has been accelerated worldwide at an unprecedented pace during COVID-19 pandemic. Since then, online learning has become the mainstream of learning and showing a massive number of learners participate in it. According to the previous researcher, student engagement, known as student involvement, learning involvement, learning participation, and it has been getting more agitation (Hu & Li, 2017). But the problem arises on whether ODL implementation has satisfied the learners in their academic achievement (Mathew & Chung, 2020). Other than that, satisfaction on whether students' engagement in online learning when both instructors and learners were urged to proceed with ODL. According to Hu & Li (2017), students' engagement is a multidimensional concept, including both explicit behaviour and emotional and psychological reflection.

Mathew & Chung (2020) investigated on the university students' perspectives on ODL learning during COVID-19. Based on the findings, most students have positive perceptions on ODL implementation. On the other hand, adapting to ODL seems to take longer time than expected for the first-year pharmacy students because they struggled to manage their lives and studies and required more support and direct instruction (Abdul Rahim & Choo, 2021). Meanwhile, Chokwe (2015) said that in terms of online feedback provided to students, it was not sufficient and therefore denying students' opportunities to learn effectively.

In another study by Hollister et al (2022) students struggled to stay connected with their peers and instructors and found it difficult to managing with the pace of coursework as well. Nonetheless, they had positive impressions towards instructional staff. Based on the constructivism theory, learners construct their own knowledge instead of inactively absorbing information given to them (Brunner, 1966). During ODL learners need to be independent and proactive since they are in their private space. So, the relationship between the components

of constructivism with online interaction needs to be elucidated since the students have different perceptions and issues in online learning based on their exposure and courses. With that, this quantitative study is done to explore perception of learners on their perceptions towards constructivism in online interaction of genetic learning among undergraduates.

Objective of the Study and Research Questions

This study is done to explore the perception of learners on their perception of online learning. Specifically, this study is done to answer the following questions;

- How do learners perceive learning in groups for online learning?
- How do learners perceive teachers as facilitators for online learning?
- How do learners perceive shared knowledge & authority for online learning?
- Is there a relationship between components of constructivism in online learning?

Literature Review

Drawbacks of Online Learning

Online learning promotes individuality over teamwork, which is vital for developing students' ability to collaborate with others. Inadequate student involvement, particularly in crucial disciplines in biology such as genetics, has long been an issue for online learning. To improve learner performance, educators must focus more on intervention and the selection and design of online learning platforms and content (Du *et al.*, 2022). They may lose interest in the subject, jeopardising their overall performance.

Benefits of Online Learning

Online learning, on the other hand, provides flexibility that corresponds to the notion of "lifelong learning," while also promising ease and more freedom. (Kokoç, 2019). The online student was allowed to customise the learning timetable and style while adapting to most learning approaches. It benefits students who are digitally proficient and makes the learning process more convenient and accessible.

Past Studies on Benefits of Online Learning

Online learning permits learners to work at a place and time that is appropriate with their learning needs. 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, El Emary, Hariguna, & Qhal, 2022; Xhaferi & Xhaferi, 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.

There have been many past studies on the benefit of online learning. During COVID 19 pandemic, Xhaferi & Xhaferi (2020) analysed the data on the benefits and challenges of online teaching at South East European University (SEEU). 65 participants were students of the BA level majoring in English Language and Literature and German Language and Literature at SEEU in Tetovo, North Macedonia. Instrument used was the students' questionnaires which contained 15 questions. Generally, the research summarised those benefits of online coursework outweighed the challenges during the online classes. They suggested and emphasized the need to consider the impact of online teaching on student motivation and

their study raises important questions about how to best support students enrolled in online courses.

Next, the study by (Hongsuchon *et al.*, 2022) they look at the impact of effectiveness and benefit of online learning in Knowledge Management. The questionnaires were distributed to 474 students who were enrolled in online learning via a Google form. They used SmartPLS 2.0 software to analyse the data. 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. The implication of their research showed that learning objectives could enable institutions to increase the effectiveness of students' online learning by motivating students to join online classes and developing appropriate learning strategies for an individual's needs.

Meanwhile, Hollister *et al* (2022) in their study explores on how a constructivist-based instructional design helped 32 adult learners learn in an online learning environment at a National University in Taiwan. The data from the study consisted of course documents, submitted artefacts, surveys, interviews, in-class observations, and online observations. 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 in order for them to have proposed a facilitation model, which intends to provide a clearer role, objectives and associated tasks for each of the involving parties in the learning community itself.

Conceptual Framework

Figure 1 shows the conceptual framework of the study. This study explores online interaction via Brunner's (1966) theory of constructivism. Online classrooms have taken over the many traditional classrooms. One worry about online classes is the worry about interaction among the learner, teachers, and the content of the lesson (Rahmat, 2022). According to Brunner (1966), constructivism is the theory that says learners construct their own knowledge instead of passively absorbing information given to them. Constructivism involves (a) learning in groups, (b) teacher as facilitator as well as (c) shared knowledge and authority. The four characteristics of constructivism by Brunner (1966) is scaffolded into the types of interaction by Martin & Bolliger (2018) of learner-to-learner, learner-to-instructor, and learner-to-content interaction to reveal the framework in Figure 1.

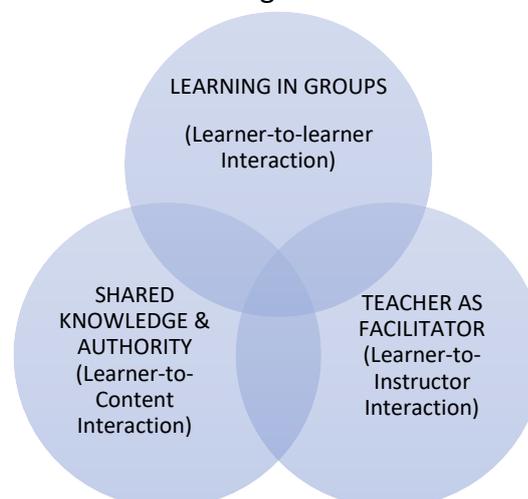


Figure 1- Conceptual Framework of the Study-
Online Learning and Constructivism

Methodology

This quantitative study is done to explore motivation factors for learning among undergraduates. A purposive sample of 124 participants responded to the survey. The instrument used is a 5 Likert-scale survey and is rooted from Brunner (1966) and Martin & Bolliger (2018) to reveal the variables in table 1 below. The survey has 4 sections. Section A has items on demographic profile. Section B has 6 items on learning in groups. Section C has 8 items on the teacher as a facilitator. Section D has 8 items on shared knowledge & authority.

Table 1
Distribution of Items in the Survey

SECTION	CONTRUCTIVISM (Brunner, 1966)	TYPE OF INTERACTION (Martin & Bolliger, 2018)	No of Items
B	LEARNING IN GROUPS	Learner-to-learner	6
C	TEACHER AS FACILITATOR	Learner-to-Instructor	7
D	SHARED KNOWLEDGE & AUTHORITY	Learner-to-Content	8
		Tot no. of Item	21

Table 2
Reliability of Survey

Cronbach's Alpha	N of Items
.896	21

Table 2 shows the reliability of the survey. The analysis shows a Cronbach alpha of .896, thus, revealing a good reliability of the instrument chosen/used. Further analysis using SPSS is done to present findings to answer the research questions for this study.

Findings

Findings for Demographic Profile

The demographic profiles of the respondents are shown in Table 3. The majority of respondents (n=29, or 23%) are female students. The most preference topic for online study is genetic topic with n=87(70%) compared to genetic technology topics. The two topics are constituents of the semester I syllabus of students. YouTube platform has been used extensively used in learning these two chapters but using different channels. According to the study, students prefer general YouTube channels (n=82(66%)) over instructor-created channels (n=82(66%)). This is because most students live on campus, n=99(70%) study online in college rather than at home. Students also reported varying levels of internet access, with n=87 (70%) reporting medium access. For the midterm exam, the average student result is B (n=51,42%), followed by C (n=31,24%). Genetics is the study of heredity, which is the study of

genes and factors connected to all aspects of genes, whereas genetic technology is the use of technology to modify or manipulate an organism's genes.

Table 3

Demographic Profiles

Characteristic		n	Percentage (%)
Gender	Male	29	23
	Female	95	77
Preference Biology Topic for online study	Genetic	87	70
	Gene Technology	37	30
Source of Video	AsiD Biology Channel	42	34
	General YouTube Channel	82	66
Learning location	Home	25	20
	College	99	80
Internet Access	Slow	17	14
	Medium	87	70
	Strong	20	16
Mid Term Score	A	20	16
	B	51	42
	C	31	24
	D	22	18

Findings for Learning in Groups

This section presents data to answer research question 1- How do learners perceive learning in groups for online learning? In the context of this study, learning in groups is measured by learner-to-learner interaction.

Learner-To-Learner Interaction

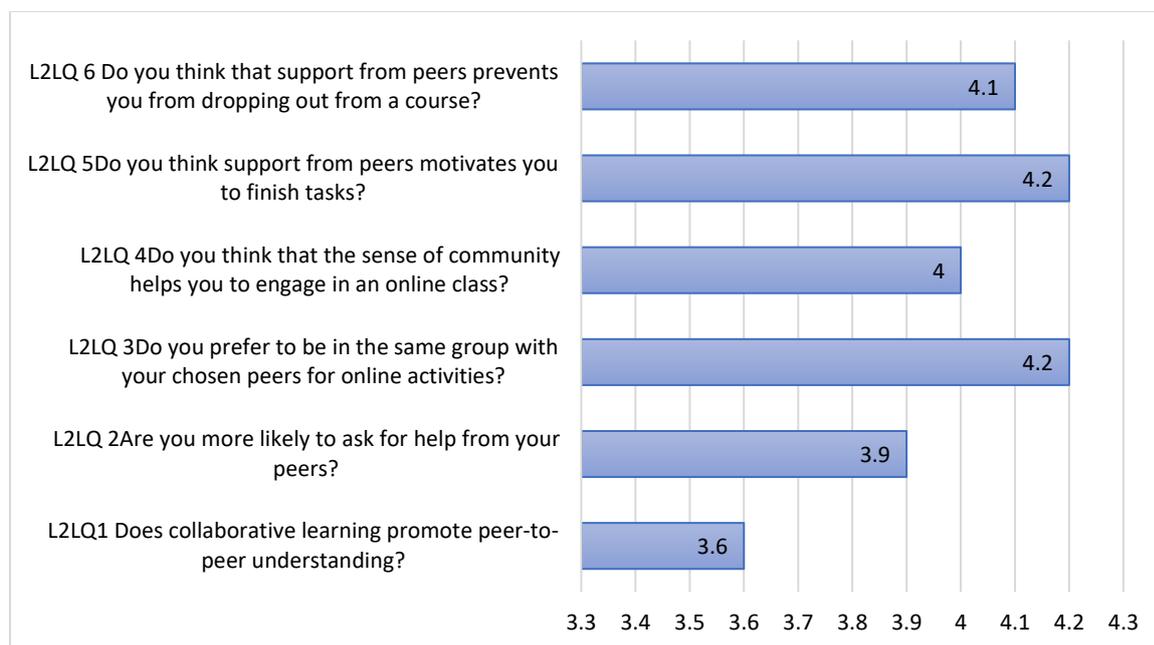


Figure 2- Mean for Learner-to-Learner Interaction

Figure 2 shows means for learner-to-learner interaction. From the table, most of the respondents prefer to be in the same group with chosen peers for online activities and perceive support from peers motivates them to finish their tasks with the mean 4.2 respectively for items 3 and 5. Other than that, respondents believe that support from peers prevent them from dropping out of course with mean value is 4.1 which is item 6. Furthermore, the respondent considers that the sense of community helps them to engage in online class with the mean value 4 for item 4. Respondents may ask for help from peer and perceived collaborative learning promote peer-to-peer understanding the least with mean 3.9 and 3.6 respectively for items 2 and 1. Overall, there is positive feedback on learning in groups which is measured by learner-to-learner interaction.

Findings for Teachers as facilitators

This section presents data to answer research question 2- How do learners perceive teachers as facilitators for online learning? In the context of this study, this is measured by learner-to-instructor interaction.

Learner-to-Instructor Interaction

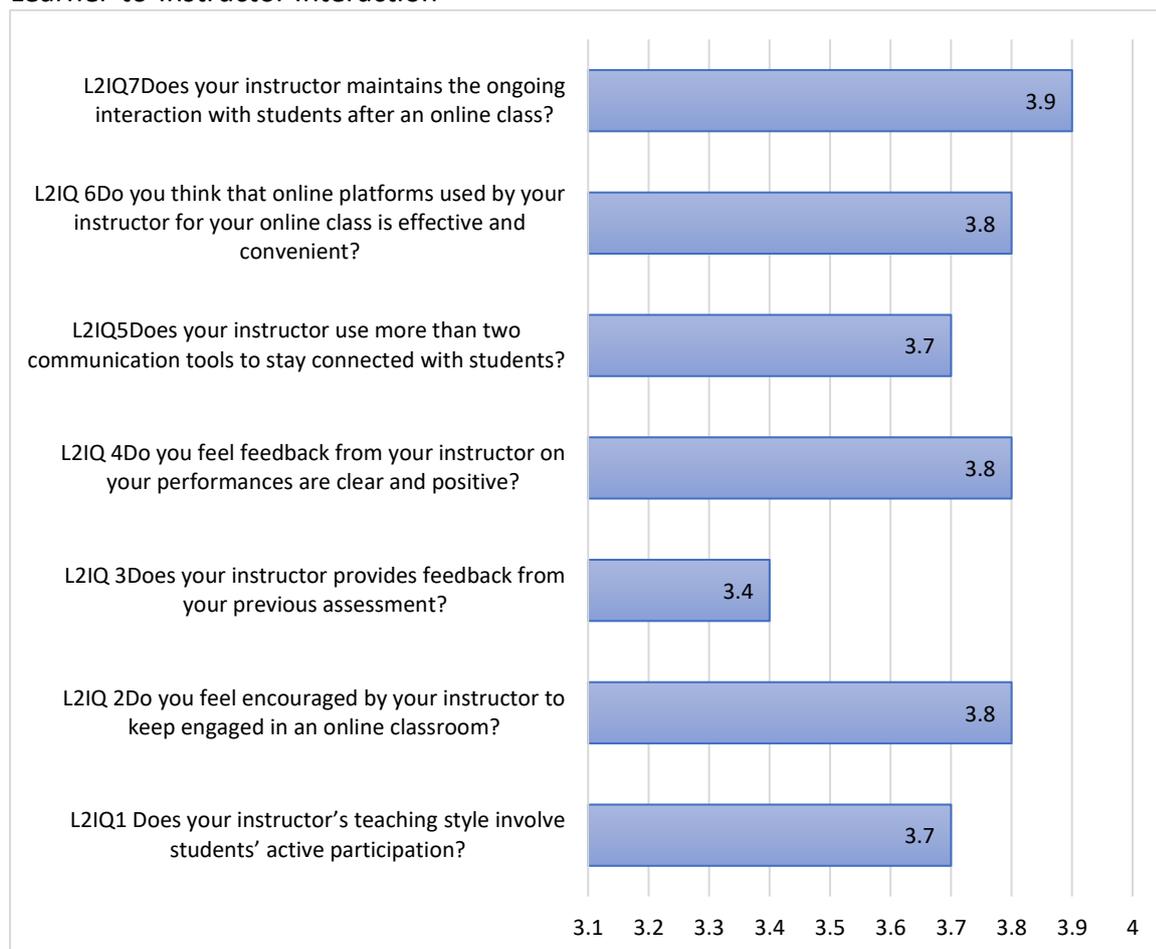


Figure 3- Learner-to-Instructor Interaction

Figure 3 shows means for learner-to-instructor interaction. From the table, the respondents perceived their instructor maintains the ongoing interaction with students after online class with highest mean value is 3.9 for item 7. Followed by feel encouraged by their instructor to keep engaged in an online classroom, feel feedback from your instructor on their performances are clear and positive and think that online platforms used by their instructor for your online class are effective and convenient with mean values 3.8 each for items 2, 4 and 6. Respondents believed that the instructor's teaching style involve students' active participation and instructor uses more than two communication tools to stay connected with students with mean values 3.7 for items 1 and 5. The lowest mean value is 3.4 for item 3 refers to an instructor's feedback from their previous assessment regarding the interaction between learner-to-instructor. Overall, there is positive feedback on teachers as facilitators for online learning measured by learner-to-instructor interaction.

Findings for Shared Knowledge & Authority

This section presents data to answer research question 3- How do learners perceive shared knowledge & authority for online learning?

Learner-to-Content Interaction

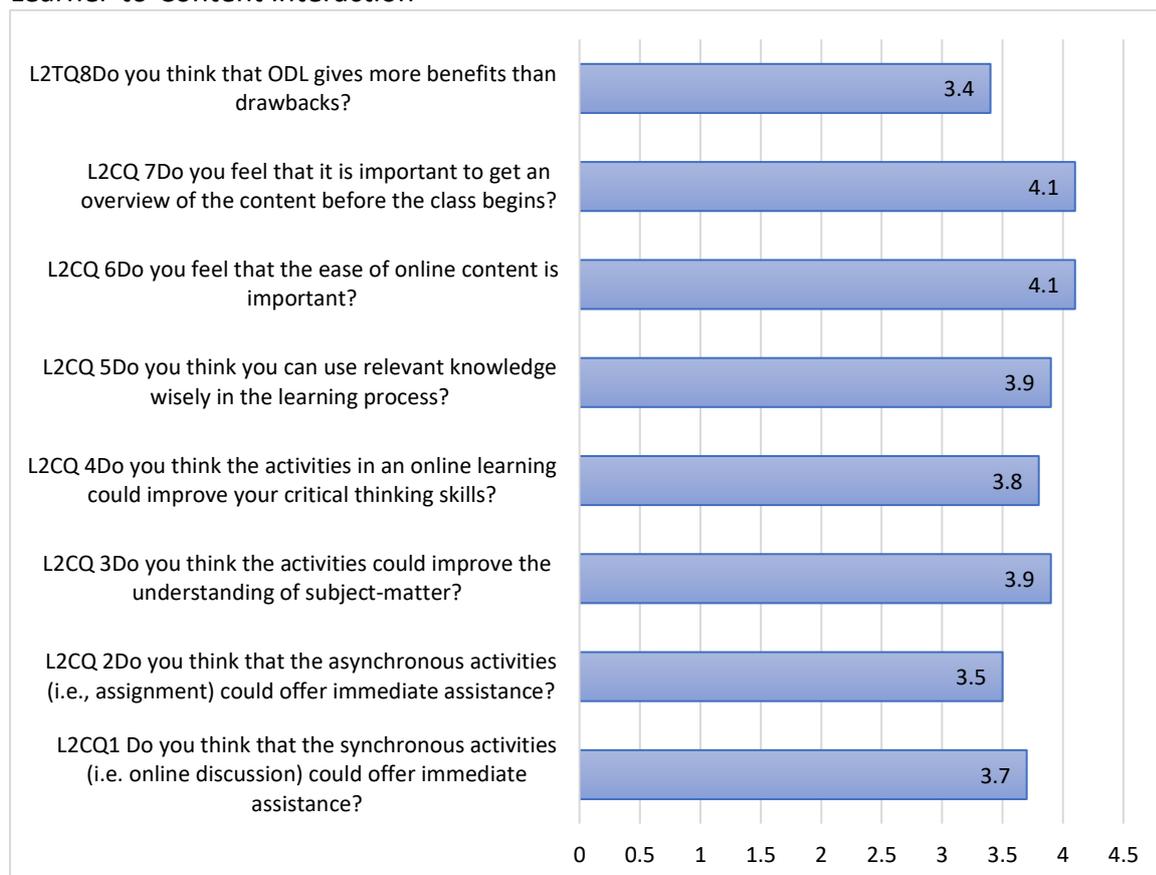


Figure 4- Mean for Learner-to-content interaction

With reference to figure 4, the highest mean represents by the item 6 and 7 respectively with 4.1. Learners also perceive that the ease of the online content is important in online learning. Besides, it's necessary for the students to have reviews on the content before the beginning of the class as a learning preparation. The lowest means with 3.4 is item 8 which highlights the benefits and drawback of ODL in learning genetic and genetic technology. Students have a fair opinion that ODL could provide more benefits in learning.

Findings for Relationship between

This section presents data to answer research question 4- Is there a relationship between components of constructivism in online learning? To determine if there is a significant association in the mean scores between learning in groups, teacher and facilitator and shared knowledge and authority data is analysed using SPSS for correlations. Results were presented separately in table 4, 5 and 6 below.

Table 4

Correlation between Learning in Groups and Teacher as Facilitator

Correlations

		LEARNINGin GROUPS	TEACHERFAC ILITATOR
LEARNINGin GROUPS	Pearson Correlation	1	.475**
	Sig. (2-tailed)		.000
	N	124	124
TEACHERFACILITATOR	Pearson Correlation	.475**	1
	Sig. (2-tailed)	.000	
	N	124	124

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4 shows there is an association between learning in groups and teachers as facilitators. Correlation analysis shows that there is a moderate significant association between learning in groups and teachers as facilitators ($r=.475^{**}$) and ($p=.000$). According to Jackson (2015), coefficient is significant at the .05 level and positive correlation is measured on a 0.1 to 1.0 scale. Weak positive correlation would be in the range of 0.1 to 0.3, moderate positive correlation from 0.3 to 0.5, and strong positive correlation from 0.5 to 1.0. This means that there is also a moderate positive relationship between learning in groups and having teachers as facilitators.

Table 5

Correlation between Teacher as Facilitator and Shared Knowledge & Authority

Correlations

		TEACHERFAC ILITATOR	SHAREDKNO WLEDGE
TEACHERFACILITATOR	Pearson Correlation	1	.687**
	Sig. (2-tailed)		.000
	N	124	124
SHAREDKNOWLEDGE	Pearson Correlation	.687**	1
	Sig. (2-tailed)	.000	
	N	124	124

**. Correlation is significant at the 0.01 level (2-tailed).

Table 5 shows there is an association between teachers as facilitators and shared knowledge & authority. Correlation analysis shows that there is a strong significant association between teachers as facilitator and shared knowledge & authority ($r=.687^{**}$) and ($p=.000$). According to Jackson (2015), coefficient is significant at the .05 level and positive correlation is measured on a 0.1 to 1.0 scale. Weak positive correlation would be in the range of 0.1 to 0.3, moderate positive correlation from 0.3 to 0.5, and strong positive correlation from 0.5 to 1.0. This means that there is also a strong positive relationship between teachers as facilitators also between shared knowledge & authority.

Table 6

*Correlation between Shared Knowledge & Authority and Learning in Groups***Correlations**

		SHAREDKNOWLEDGE	LEARNINGin GROUPS
SHAREDKNOWLEDGE	Pearson Correlation	1	.512**
	Sig. (2-tailed)		.000
	N	124	124
LEARNINGinGROUPS	Pearson Correlation	.512**	1
	Sig. (2-tailed)	.000	
	N	124	124

** . Correlation is significant at the 0.01 level (2-tailed).

Table 6 shows there is an association between shared knowledge & authority and learning in groups. Correlation analysis shows that there is a strong significant association between shared knowledge & authority and learning in groups ($r=.512^{**}$) and ($p=.000$). According to Jackson (2015), coefficient is significant at the .05 level and positive correlation is measured on a 0.1 to 1.0 scale. Weak positive correlation would be in the range of 0.1 to 0.3, moderate positive correlation from 0.3 to 0.5, and strong positive correlation from 0.5 to 1.0. This means that there is also a strong positive relationship between shared knowledge & authority and learning in groups.

Conclusion**Summary of Findings and Discussions**

With $\bar{x}=4.2$, the highest mean value, learners consider that peer interaction in biology online learning activities is crucial for task completion and motivation support. Learners also believed that continued engagement with students following an online class is crucial with $\bar{x}=3.9$ to ensure that the online learning outcome is met. In addition, the learner also believes that the simplicity of the online content is significant in online learning as they perceive that the necessary review and ease of the online content is important with $\bar{x}=4.1$. Peer and instructor participation in social interaction leads to increased learning satisfaction, a stronger sense of community, and enhancement of the learning community (Colbeck *et al.*, 2014). According to Andyhapsari and Djukri, 2020, the use of Project Based Learning (PBL) in biology learning creates greater engagement, such as a question-and-answer session between the instructor and the students. It also help students to comprehend the content. According to Bringman-Rodenbarger and Hortsch (2020), regardless of interactive, user-friendly of e-learning platform, students' choice always goes to the most familiar and convenient e-learning content. To attract more students to learn using an online platform, the usage of online learning in biology must be improved with specific improvements in forms of content, activity, and execution. Creative and interactive online material, the ease of the online platform that be used may help the biology students to learn effectively while implied constructivism in the process. It thus develops the new environment of teaching and learning in biology which previously known to be challenging.

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