Interaction patterns in online/distance learning at higher education: a case study of biology education

Amalia Sapriati*, Ucu Rahayu, Dyah Aniza Kismiati, Zakirman Zakirman, Ojat Darojat
Universitas Terbuka, Indonesia
*Corresponding Author: lia@ecampus.ut.ac.id

ABSTRACT

This study investigates tutor-student interaction patterns in online learning environments, aiming to unveil effective strategies for optimising the online educational experience. Guided by a qualitative approach employing a case study design, this study delves into the interaction and written communication dynamics among 65 students and their tutors participating in four-course programs within the biology education study program. The observational and analytical phases focused on unravelling the nuances of online interactions. Subsequently, follow-up interviews were conducted to glean deeper insights and understanding into the observed patterns of communication and engagement between students and tutors. Through the qualitative analysis procedure, five distinct interaction patterns emerged from the analysis, ranging from tutor-initiated questions to collaborative exchanges among students and tutors. Each pattern offers unique insights into fostering engagement, feedback, and peer-to-peer learning dynamics. As online education continues to evolve, understanding and leveraging these identified tutor-student interaction patterns provide valuable insights for educators and instructional designers. Recognising the diverse ways in which interactions unfold is instrumental in enhancing the quality and effectiveness of online learning, fostering student engagement, and achieving the overarching goals of online education.

Keywords: Biology education, distance learning, online learning, pattern interaction

INTRODUCTION

All interactions between humans or involving media are crucial in face-to-face and distance education and represent integral components of quality education (Bağrıacık Yılmaz & Karataş, 2018). The quality of classroom interactions between teachers and students consistently predicts social relationships, behavior, emotional development, and academic performance (Hu et al., 2019). In distance education, interaction is pivotal in the dynamic among learners, instructors, and course content (Cetinkaya & Keser, 2018). Interaction, defined as the mutual influence shared among individuals, is an active process through which they exchange, acquire, and retain knowledge (Allami et al., 2022).

Online tutorials provide an alternative learning service for distance education students at distance education universities in Indonesia. The utilization of this service has seen a substantial increase, surging by over one hundred percent, from 6,352 students in 2010 to 26,000 in 2016 and reaching more than 500,000 students in 2023 (Universitas Terbuka, 2023). Consistent with the findings of Allen & Seaman (2010), the growth in the number of students engaging in online learning over six years from 2022 to 2008 was around 19%. This underscores the significant rise in the adoption of online learning over the past decade.

However, several challenges persist, hindering optimal participation in online tutorials. Some tutors struggle to adapt to learner-centred learning models, a crucial requirement in online-

based education. Additionally, a subset of students remains hesitant and confused about online learning. Certain learning objectives and topics, such as laboratory exercises, teaching practices, and psychomotor skills, cannot be effectively conveyed through computers. Bandwidth limitations, delayed responses to questions, and infrastructure support deficiencies further compound the issue. The provision of training for both students and teachers are also minimal (Simonson et al., 2011). These limitations impact students' engagement during the online tutorial process, reflecting on the patterns of interaction between tutors and students.

In the online/distance learning environment, the emphasis on interaction is paramount, as it activates the learner's educational experience, providing opportunities to tailor learning to individual needs and skills through practical experiences. This interaction supports clarifying new ideas and fosters associations with existing concepts (Bagriacik Yilmaz & Banyard, 2020). In the dynamic realm of online classes, students actively participate in social and cognitive interactions involving reading and responding to instructor and peer posts. Online learning facilitates a platform where students can not only share their ideas with classmates but also enhance their understanding by reading and reflecting on other students' posts, thus allowing for meaningful comparisons of progress (Khlaif et al., 2017).

In a learning environment, interpersonal interactions between students and tutors serve several crucial purposes: 1) Encouraging contact between students and tutors, 2) Fostering cooperation among students, 3) Offering prompt feedback, and 4) Communicating high expectations (Mehall, 2020). Key considerations in these interactions encompass various aspects, such as the form of engagement with content, collaboration, communication, assistance in monitoring and regulating learning (intrapersonal interaction), and performance support (Woo & Reeves, 2007).

Within the evolving landscape of online learning environments, researchers and instructional designers have shifted their focus from learner-content interaction to more nuanced learner-student interaction. This transition also emphasizes the quality of interaction over sheer quantity (Woo & Reeves, 2007). The interactions in distance education can be categorized into three main types: interactions between students and content, interactions between students and teachers, and interactions between students themselves (Abrami et al., 2011; Bagriacik Yilmaz & Banyard, 2020; Berg, 2020; Coskun & Demirci, 2021; C.-Q. Huang et al., 2019; Moore & Kearsley, n.d.). Some experts introduce a fourth interaction: the interaction between the learner and the interface (Hillman et al., 1994; Miltiadou & Savenye, 2003). The patterns can be seen in Table 1.

Table 1. Interaction patterns in online/distance learning environments

Interaction Patterns	Description
Student and content	The interaction of intellectuals between students with the topic of learning. one-way interaction and can be seen from the frequency of student involvement when opening initiation material in the form of text/text, video, or animation
Student and instructor/tutor	The instructor is responsible for stimulating and retaining students to be interested in learning the topics presented, motivating, providing support and encouraging students to learn, and evaluating students' achievements
Student and other students	Inter-participant interaction occurs between students in the online environment with or without the presence of instructors. Communication between one student and another in one group of students both synchronously and asynchronously
Student and interfaces	The process of manipulating tools to complete tasks.

Furthermore, interaction patterns in online learning are classified based on their direction, comprising one-way, two-way, and multi-way interactions (Pham et al., 2014), as displayed in

Figure 1. These intricate patterns underscore the multifaceted nature of online learning, where engagement and collaboration play pivotal roles in fostering a rich and effective educational experience.
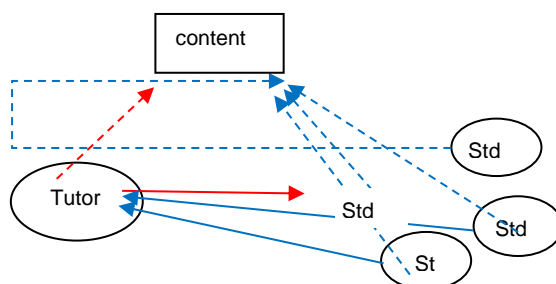

Figure 1. Interaction Patterns: The Instructor Initiated

Interaction has emerged as a prominent research focus in online education, with recent studies indicating its positive impact on student learning outcomes (Karakara & Osabuohien, 2020; Mehall, 2020). The online learning system necessitates a heightened level of responsibility on the part of students for their learning. Successful online learners must exhibit a strong sense of learning responsibility and independence.

Existing research substantiates the notion that interaction among learners is a pivotal component contributing to the effectiveness of an active learning environment, recognizing participant interaction as a crucial form of classroom engagement (Blanchette, 2012). Interactions between teachers and students can enhance motivation by shaping the perception of competence and relatedness. Positive interactions contribute to the experience of competence, particularly when students are encouraged to tackle challenging activities and assignments while receiving constructive feedback from teachers (Rivera Munoz et al., 2020).

Numerous studies emphasize the significance of interactions in the distance education environment, recognizing them as pivotal factors that can significantly impact the success or failure of a student's learning experience (Miltiadou & Savenye, 2003; Vrasidas & McIsaac, 1999; York & Richardson, 2012). Miltiadou and Savenye (2003) demonstrated a positive correlation between a high level of interaction and learning effectiveness in distance education. Vrasidas and McIsaac (1999) delved into factors influencing student interaction, highlighting the impact of the course structure, class size, feedback mechanisms, and students' previous experiences in online learning.

Similarly, York and Richardson (2012) contributed to this understanding by identifying key factors that influence interaction in online learning environments, such as the community learning environment, the quality of instructor feedback, the nature of posed questions, the effectiveness of lecture instructions, and the degree of instructor participation.

While these studies provide valuable insights into the factors shaping interaction in online learning, a notable research gap exists. The identified interactions of students within the Biology Education study program are crucial in understanding the dynamics of interaction; however, a comprehensive exploration of the nuanced how patterns of interaction among them in online/distance education remains limited. Indeed, the dynamic nature of new interaction and communication patterns among online/distance students and tutors is evolving alongside the diversity of multimedia and communication channels, including visual and multimedia texts. As technology advances, the educational landscape witnesses an expansion in the possibilities for engaging and collaborative experiences. The incorporation of diverse multimedia elements not only enriches the learning environment but opens avenues for new interaction patterns in online/distance education. Further research, therefore, could examine the specific interaction patterns during the online/distance course system within the Biology Education study program, offering a more nuanced understanding of how these interaction patterns contribute to the overall quality of interaction in distance education. As a result, this current study was guided by the

following research questions: How have the patterns of tutor-student interaction unfolded in online learning within the biology education study program in Indonesia?

METHOD

The present study aimed to explore the interaction patterns among students and tutors in an online/distance learning system, particularly a biology education study program. The qualitative research approach, which is addressed to explore the meaning of individuals or groups ascribing to a social or human problem in a natural setting (Creswell & Poth, 2017; Yin, 2016), was employed to guide the research procedure. In this study, researchers tried to delve into the interaction patterns among students and tutors in the setting of an online/distance learning system.

The course and the participants

To obtain the data on the interaction patterns of students in the Biology Education study program within online/distance learning, the participants were purposefully recruited from the students who registered in this study program through purposive sampling. The total participants were 65 from four tutorial course programs, as displayed in Table 2. Furthermore, Table 3 shows the locations where the 65 participants came from. The locations of the participants are North Sumatra (A), Bengkulu (B), Batam (C), Lampung (D), Banten (E), West Java (F), Central Java (G), East Java (H), West Kalimantan (I), and North Sulawesi (J).

Table 2. The participants in the online/distance course

Online tutorial course	Student-Participants		
	Male	Female	Total
Biology Learning Strategy (BLS)	5	9	14
Evaluation of Biology Learning (EBL)	1	8	9
Human Anatomy and Physiology (HAP)	4	13	17
Animal Development (AD)	5	20	25

Table 3. The location of the participants

Online tutorial course	Location of Student-Participants									
	A	B	C	D	E	F	G	H	I	J
Biology Learning Strategy (BLS)	1			2		4	4	2	1	
Evaluation of Biology Learning (EBL)						4	3	1		1
Human Anatomy and Physiology (HAP)		1	1	1	2	2	2	4	2	2
Animal Development (AD)	2				2	5		16		25

The online/distance course program also spanned eight weeks and incorporated various learning activities, including material delivery and assignments. A detailed overview of these activities is provided in Table 4, highlighting the diverse components that contributed to the comprehensive learning experience. Besides, the students were tasked with actively participating in the designated Discussion Forums provided each week.

Table 4. Online/distance course activity

Week	Course Activity
1	Introduction to and assignment in self-study and independent learning on learning plan, target and learning schedule
2, 4, 6, 8	Providing content materials and assignments in designing and monitoring learning plans, targets and learning schedules through mind mapping
3, 5, 7	Tutorial assignments related to the content materials

Instrumentation and data analysis

Two research instruments were used to collect the data on interaction patterns among tutor-student in online learning: documentation/observation and interview. At the first step in data collection, communication and interaction among students and tutors in the designated discussion

forums were recorded and collected. The entire written communication within eight discussions from four-course programs was subject to analyze. The online discussions took place in the first language of both students and tutors, Bahasa Indonesia. Subsequently, they were translated into English for the purpose of data presentation.

During the second stage, interviews were conducted to better understand the events and phenomena related to interaction and communication observed in the Forums. Three students from each course program were invited to participate in these interview sessions, which took place through face-to-face interviews and recorded telephone calls, depending on the participants' preferences.

A qualitative procedure was employed to analyse the data, following the approach proposed by Miles and Huberman (Miles et al., 1994). This method involved sequential steps, including data reduction and analysis, data display, and conclusion. This approach was chosen to effectively address the research question effectively, allowing for a comprehensive examination of the gathered information.

FINDINGS AND DISCUSSION

This current research seeks to explore the interaction patterns among students and tutors in the online/distance learning system, specifically focusing on the Biology Education study program. Following the analysis of data obtained from the observation of discussion forums and interviews, five distinct interaction patterns were identified based on the delivery of questions (i.e., the initial poser of the question): 1) Tutor-to-students question; 2) Tutor-to-students question and feedback by tutor, 3) Tutor-questions and responses by students and tutor; 4) Questions from and responded by students; 5) Questions from tutor/student with no responses. These interaction patterns are presented in further detail below.

Findings
Tutor-to-students question
In this pattern, the tutor initiates the question, addressing it to the students. From written communication and interaction within discussion forums and assignments, an interaction pattern is observed where the initiation originates from the tutor. While some students actively respond to the tutor's initiation, some refrain from participating. Notably, in this context, the tutor does not provide student feedback. This phenomenon is noted in the online Discussion Forum of the BLS course and in the online assignments of AD, BLS, and EBL, as in the sample excerpt below.

> *Tutor: Could you explain the statement that there is no best method in teaching but the most suitable teaching method, "Give an example in teaching Biology?"*
> *Student 1: In my opinion, in the delivery of learning material, we need to choose and apply methods that are in accordance with the material or concepts. Example: Basic competence (BD)*
> *5.3: Using a microscope and other supporting equipment to observe the symptoms of life. To achieve this BD, not all learning methods are appropriate. Demonstration or practical work is a more appropriate method for teaching this concept than giving a lecture*
> *The tutor was quiet (no response).*
> *Student 2 was quiet (no response)*
> *Student 3: The teaching method must be adapted to the material's topic or the concept we will give to students. For example :1. method of lecturing and discussion are suitable for making scientific reports. 2. methods of lecturing and experiment are suitable for the teaching of genetics.*
> *Tutor: No response*
> *Student 4: In my opinion, in the teaching and learning process, the teacher must have a suitable learning strategy so that students can learn effectively to reach the expected goals. Every lesson delivered requires the selection of the right method.*

The experimental method provides opportunities for students to find their own concepts through observation with the power of reasoning, thinking power and creativity.
The tutor was being quiet (no response)

The reduced data from the excerpt above showed that Student 1 emphasised the importance of a method that aligns with the material or concept. Meanwhile, Student 2 did not give any response. Student 3 agreed that the teaching method should be adapted to the topic of the material or the concept. Student 4 highlighted the need for a suitable strategy in teaching, suggesting that experimental methods help students discover concepts independently. The excerpt from the discussion forum suggested that no single "best" teaching method exists. Instead, the most suitable method varies depending on the material, the learning objectives, and the needs of the students.

Figure 2 illustrates that at the commencement of the discussion, the tutor introduced topics and discussion issues related to the content. While some students responded to the tutor, others chose not to engage. Through interviews, we found that students refrained from responding due to time constraints, heavy course loads, and professional responsibilities, such as preparing their students for national examinations. Additionally, tutors did not provide feedback to their students. In this scenario, the interaction between students was not evident.
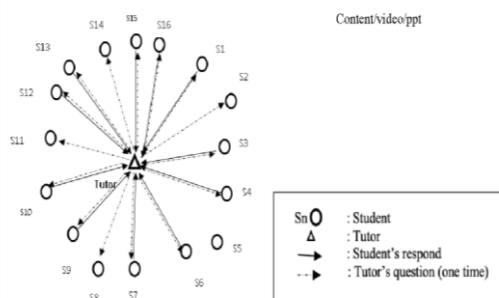

Figure 2. Pattern 1: Tutor-to-students Question (Representative Samples)

Tutor-to-student questions and feedback by the tutor

This pattern involves the tutor posing a question to the students, followed by feedback provided by the tutor. Some students responded to the question, while others refrained from doing so. Subsequently, the tutor provided feedback related to the students' answers. This phenomenon was observed in the online assignment component of the HAP course. Notably, following the tutor's feedback on the first assignment, there was a notable increase in the number of students who engaged with subsequent assignments. Compared to other courses, the HAP online course witnessed a significantly higher participation rate among students completing assignments. This observation underscores the impact of tutor feedback in enhancing student self-efficacy, leading to greater consistency in assignment participation. This aligns with the perspective of Abrami et al. (2011), which emphasizes the importance of clear and accurate feedback from tutors to foster the self-efficacy and competency of distance students. Figure 3 illustrates this second type of interaction pattern.

Tutor-question and responses by students and tutor

Here, both the tutor and students pose questions and provide responses, fostering a dynamic exchange. Varying levels of student response characterize the interaction pattern in which the initiation originates from the tutor. While some students engage with the tutor's initiation, others choose not to participate. Subsequently, the tutor provides feedback, prompting additional responses from other students based on the feedback given. This phenomenon is observed within the discussion forum of the AD course. The dynamic nature of this interaction pattern reflects the iterative process of engagement between the tutor and students, fostering collaborative discussion within the course forum, as reflected in the sample excerpt.
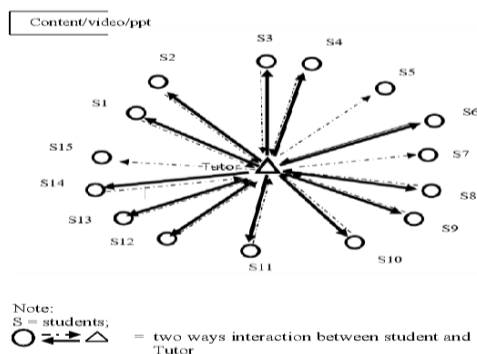
Figure 3. Pattern 2: Tutor-to students Question and Feedback by Tutor
(Representative Samples of HAP Course)

Tutor: Please, watch the Video of Gametogenesis 1 and 2! Identify the details of the spermiogenesis process and then describe it.
Student 1: Spermiogenesis is the stage of transformation in which spermatids change shape from round to spermatozoa, consisting of a head, neck, and tail. At this stage, morphological and functional changes occur without further cell division.
Tutor: Very good.
Student 2: In the process of spermiogenesis, spermatids do not divide anymore, but They will change to become sperm. In this stage occurred radical changes.
Student 3: At this stage, the process starts from spermatogonium, which genetically diploid spermatogonium produces primary spermatosis through mitosis.
Tutor: Student 3, your answer is not correct; you should re-read the topics of spermiogenesis until you understand the process of spermiogenesis!”
Student 4: Spermiogenesis is the event of changes in spermatids into adult sperm. Spermiogenesis occurs in the epididymis and takes 2 days. Spermiogenesis is divided into 4 stages: (1) Golgi formation, axoneme and DNA condensation; (2) Formation of an acrosome stamp; (3) Formation of the tail; (4) Maturation, cytoplasmic reduction diffagocyted by Sertoli cells.
Tutor: Good answer. Your answers can complement your friends' answers. All your responses are complementary answers

The excerpt above suggested that Students 1, 2 and 4 all mentioned that spermatids undergo morphological changes to become mature sperm. Student 1 mentioned that the changes appeared in shape (head, neck and tail), while Student 4 elaborated on the stages of the structural changes, including the formation of Golgi, acrosome and tail. The excerpt shows that Student 1 and Student 2 agreed that there was no further cell division during the spermiogenesis. In the discussion forum, Student 4 successfully described the stages of spermiogenesis in detail. The data also indicated that Student 2 briefly highlighted the occurrence of radical changes, which corresponds with the structural and functional transformations described by others. Additionally, Student 4 introduced the role of Sertoli cells in cytoplasmic reduction, a point that none of the other students explicitly mentioned. All student responses (except Student 3) provided complementary information, contributing to a fuller understanding of spermiogenesis.

This pattern and its iterative interaction process between the tutor and students are visually depicted in Figure 4 below. The figure illustrates the dynamic nature of engagement, highlighting the continuous exchange and collaborative interaction within the course forum.

Questions from and responded to by students

In this pattern, students take the initiative by posing questions, and subsequent responses come from either other students or the tutor. Tutor-student interaction arises in response to students' challenges. This interaction begins with a tutor encouraging students to express their difficulties. This phenomenon occurs within free discussions. As depicted in Figure 5, the

discussion commences with a tutor prompting students to share material they find challenging, leading to responses from some students.
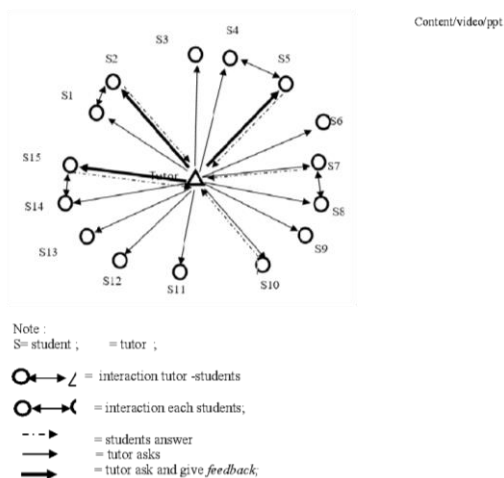

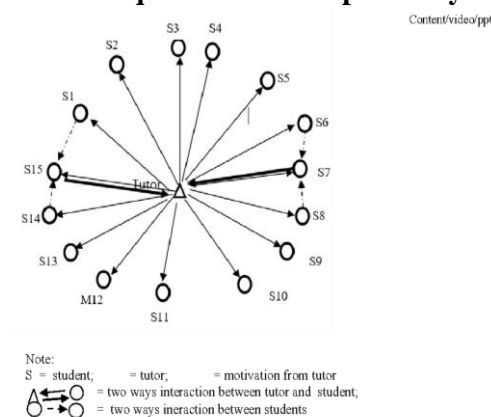**Figure 4. Pattern 3: Tutor-question and Responses by Students and Tutor**

Figure 5. Pattern 4: Questions from and Responded by Students

This interaction pattern is observed in discussions centred around difficult material in AH, HAP, and LE courses, as in the sample excerpt below.

Tutor: Please write down a question that you considered difficult material.
Student 1: Why are people suffering from anaemia weak, lacking energy and fatigued?
Student 2: This condition is caused by the function of the blood to be served food and oxygen circulation. If someone suffers from anaemia, the body's intake of nutrients is also disrupted. This can cause weakness and fatigue. Oxygen is needed by the body to stay alive. If the body lacks blood, it lacks oxygen. Someone who lacks oxygen will feel weak and tired.
Student 3: People with anaemia will feel tired quickly because they suffer from erythrocyte deficiency (haemoglobin). Haemoglobin deficiency causes the supply of oxygen to decrease.
Tutor: Please answer.
Student 4: Why the people with blood type AB known as the universal recipient?"
Student 5: People with blood type AB are called universal recipients because they can accept transfusion from any blood type A, B, O and AB themselves. They do not have antibodies against antigens A and B. For more details, see the following table.
Student 6: Because people with blood type AB can receive blood from all blood types. By receiving blood donors from various blood types, the person's body will not have

a blood clotting reaction.
Student 7: People with blood type AB will not have clots if they receive a blood transfusion from all blood types. there was no clotting during blood transfusions from all blood groups. Type AB blood contains agglutinogen A and B but does not have agglutinin in their blood plasma.

The excerpt above suggested that Student 2 and Student 3 explained the effects of anaemia, particularly how it led to weakness and fatigue due to reduced oxygen supply caused by low haemoglobin levels. Meanwhile, Students 5, 6 and 7 discussed the reason why people with AB blood type were universal recipients, emphasizing the absence of antibodies and the lack of clotting during transfusions. The patterns show that students often rely on cause-and-effect explanations to make sense of complex biological processes when dealing with difficult material.

Question from tutor/student with no responses

This pattern is characterized by questions posed by the tutor or students who receive no subsequent responses. The tutor posed a question to the student, but the student did not respond—an occurrence consistently observed in every discussion. This recurring event signifies a distinct aspect of the interaction dynamics within the online learning environment. It can be seen in the sample excerpt below.

Tutor: Could you explain the statement that there is no best method in teaching but the most suitable teaching method? Give an example in teaching Biology.
Student 1 being quiet (not respond)
Student 2 being quiet (not respond)

In general, five distinct patterns of interaction between students and tutors were observed in online/distance learning, specifically within the Biology Education study program. A summary of these observed interaction patterns is presented in Figure 6. This visual representation provides a consolidated view of the dynamics characterizing the tutor-student interactions in the online learning environment.

Figure 6. A Summary of the Observed Interaction Patterns

Discussion

Educators consider Student-teacher interaction crucial in both distance and traditional

classroom settings. The objective of such interaction is to inspire, motivate, and facilitate educational activities while encouraging the use of effective learning strategies. Correspondence education offers notable advantages in this regard, as interactions between students and instructors are individualized and not constrained by the need to address group requirements (Anderson & Garrison, 1995).

Previous research findings have unveiled a correlation between student-student interaction in online discussions and increased satisfaction with online learning (Klaif, 2017). The concept of "social presence" among students in online learning environments is pivotal in fostering student involvement and active interaction in the learning process (Wan Husssin et al., 2019). Activities such as online tutorials, encompassing discussions and debates, enhance students' independent learning. The engagement of students in online learning environments and their interactions with peers or instructors have been shown to elevate learning independence (Cavinato et al., 2021; Dubey et al., 2023; Kanuka, 2008; Sun & Rueda, 2012).

This study reinforces these findings by demonstrating that actively engaged students exhibit higher learning independence levels than their less active counterparts. Moreover, the intricate interaction process involving students, teachers, and peers in various directions creates more meaningful learning experiences. The absence of social interaction in an online learning environment can impede the learning process, underscoring the critical significance of interaction among participants in all educational settings (Bali & Liu, 2018; T. Huang, 2023; Lagat & Concepcion, 2022).

Identifying engaged online learners becomes crucial, defined as individuals consistently participating in discussion forums or learning activities, collaborating with peers, and actively engaging in lectures (Muir et al., 2019). Interaction serves as the catalyst for activating the learner's environment, providing opportunities to tailor learning needs and skills, fostering the clarification of new ideas, and associating them with existing concepts. Furthermore, interaction contributes to enabling learner control in the educational process, facilitating meaningful learning, aiding student adaptation to the program, and fostering participation and communication (Bağrıacık Yılmaz & Karataş, 2018). The multifaceted role of interaction in online learning emerges as a central aspect influencing the overall learning experience and outcomes.

As highlighted by Wang (2023), fostering interaction, establishing open and productive communication, encouraging group collaboration, and providing tutor feedback on student performance contribute to enhancing learning independence. Consequently, the design of online tutorials becomes critical, ensuring that they facilitate interaction between tutors and students, enable communication among students and tutors, and allow for seamless task completion and submission. Course designers and instructors are responsible for creating an environment where students, particularly those with negative online learning experiences, can be supported. This approach aims to cultivate online learning experiences that foster the development of self-regulated learning (SRL) strategies and technological self-efficacy.

This aligns with the perspective of Vygotsky (1978), who emphasized the significance of the social environment in learning and thinking processes. Social interaction has the transformative potential to shape and modify student learning experiences. Specifically, the Proximal Zone of student development diminishes as there is assistance from tutors or collaboration with peers. Interacting with individuals in the surrounding environment can stimulate developmental processes and foster cognitive growth (Schunk, 2012; Schunk & Usher, 2019).

Similarly, findings from the research conducted by Jung et al. (2002) concerning the impact of different types of Interaction Learning in Web-Based Instruction (WBI) echo this sentiment. The study revealed that active interaction with fellow students and collaboration in solving assigned problems during the learning process played a pivotal role. This active engagement was particularly beneficial for students lacking motivation, encouraging them to seek assistance and overcome motivational hurdles. Students who freely expressed themselves during online peer interactions or extended help to their peers potentially developed heightened motivation, leading to increased involvement in the learning process. The enhanced learning motivation stemming from interaction with other students appears to have contributed to high satisfaction with the

learning process, especially for the collaborative interaction group.

Engaging in online tutorial activities that involve interactions, such as discussions, debates, and potential brainstorming, serves as a catalyst for enhanced student self-regulated learning. Student participation in the online learning environment, coupled with interactions among students and/or instructors, has been shown to positively impact learning independence (Kanuka, 2008; Sun & Rueda, 2012). This study further establishes that actively participating students exhibit higher learning independence levels than their less active counterparts.

Moreover, the intricate process of interaction encompassing student-tutors-students and diverse directions contributes to the formation of more meaningful learning experiences. Pallof and Pratt (Bali & Liu, 2018) emphasize that the absence of social interaction in the online learning environment may impede the learning process, underscoring the pivotal role of interaction among participants in all educational settings. Recognizing and prioritizing interaction within online education can significantly enhance students' learning outcomes and experiences.

The interactions that unfold during distance online lectures at this open university are shaped not only by the content and tutors but also by the active involvement of students in fostering positive conditions. This active participation is crucial in ensuring that the interactions align with the predetermined learning achievement targets. Cultivating independent learning, self-monitoring, and self-reflection significantly influences students' learning success. Additionally, the interactions between students themselves contribute significantly to the dynamics of class discussions. The effectiveness of these discussions is intricately linked to the quality of interactions occurring among students.

Learning, whether in a face-to-face or e-learning environment, can be aptly described as an interactive and complex process involving learners, instructors, and learning resources (Kokoç & Altun, 2016). When considering the quality of online learning, the concept of interaction holds paramount importance (Bağrıacık Yılmaz & Karataş, 2018). In online education, interaction is defined as a reciprocal exchange of actions between the learner and other elements within the online learning environment (Karakara & Osabuohien, 2020). Understanding and fostering meaningful interactions in online education are key determinants of the overall learning experience and effectiveness.

Examining tutor-student interaction patterns in online learning environments has yielded valuable insights into the dynamics that shape effective online education. Five distinct interaction patterns emerged from our investigation, shedding light on the varied ways in which tutors and students engage in the online learning process. The first observed pattern, the Tutor-to-Students Question, illustrates the proactive role of tutors in initiating questions and setting the tone for student engagement. This method provides a structured approach to learning and encourages students to actively participate in the educational discourse. The second pattern, Tutor-to-Students Question and Feedback by Tutor emphasizes the importance of constructive feedback in tandem with tutor-initiated questions. This dual approach stimulates student thinking and provides a feedback loop that enhances the learning experience. In the third pattern, tutor questions and Responses by Students and Tutor, a dynamic exchange unfolds as both tutors and students contribute to the discourse. This collaborative interaction fosters a rich learning environment where knowledge is co-constructed through shared dialogue. The fourth pattern, Question from and Responded by Students, underscores the significance of student agency in posing questions. The subsequent responses from peers or tutors create a peer-to-peer learning dynamic, enriching the educational experience. Finally, the fifth pattern, Question from Tutor/Student with No Responses, highlights a potential area for improvement. Understanding the factors contributing to unanswered questions can guide interventions to foster a more responsive and engaged learning community.

CONCLUSION

The findings of this research may bring several pedagogical implications, especially in the teaching and learning process in online/distance education. Educators should adopt structured questioning strategies like the "Tutor-to-Students Question" pattern to actively engage students

and guide learning. Moreover, incorporating timely and constructive feedback, as seen in the "Tutor-to-Students Question and Feedback by Tutor" pattern, should be a pedagogical priority to enhance student understanding and performance. Additionally, encouraging collaborative interactions, as exemplified in the "Tutor-Questions and Responses by Students and Tutor" pattern, can contribute to a vibrant and collaborative online learning community. Finally, providing opportunities for student-initiated questions, as demonstrated in the "Question from and Responded by Students" pattern, empowers learners and promotes a more student-centric learning environment.

Furthermore, this present study might have its limitations. The study's focus on a specific course in the Biology Education program may limit the generalizability of findings to other disciplines or courses with different characteristics. The findings may be influenced by the specific online learning platform, institutional policies, or technological infrastructure, which may differ across educational contexts. Due to limited participant demographics, the study may limit its benefit from a more diverse participant pool regarding demographic factors, such as age, cultural background, or prior online learning experience. Therefore, future research should investigate the reasons behind unanswered questions, exploring factors such as student engagement, clarity of queries, and potential barriers to participation. In addition, conducting a comparative analysis of the effectiveness of different interaction patterns in diverse educational contexts can provide nuanced insights into the adaptability of these patterns. Moreover, longitudinal studies tracking the impact of varied interaction patterns on student learning outcomes over an extended period can offer a comprehensive understanding of the enduring effects of these approaches.

REFERENCES

Abrami, P. C., Bernard, R. M., Bures, E. M., Borokhovski, E., & Tamim, R. M. (2011). Interaction in distance education and online learning: Using evidence and theory to improve practice. *Journal of Computing in Higher Education*, *23*(2–3), 82–103. https://doi.org/10.1007/s12528-011-9043-x

Allami, F. B. M., Ishak, M., Hussin, F., Sin, I., Don, Y., & Fauzee, M. S. O. (2022). Preferred leadership styles of physical education teachers and relationship with athletes' satisfaction. *International Journal of Instruction*, *15*(2), 393–416. https://doi.org/10.29333/iji.2022.15222a

Allen, I. E., & Seaman, J. (2010). *Class differences: Online education in the United States, 2010.* Babson Survey Research Group. https://files.eric.ed.gov/fulltext/ED529952.pdf

Anderson, T. D., & Garrison, D. R. (1995). Transactional issues in distance education: The impact of design in audioteleconferencing. *American Journal of Distance Education*, *9*(2). https://eric.ed.gov/?id=EJ512279

Bagriacik Yilmaz, A., & Banyard, P. (2020). Engagement in distance education settings: A trend analysis. *Turkish Online Journal of Distance Education*, *21*(1), 101–120. https://doi.org/10.17718/tojde.690362

Bağrıacık Yılmaz, A., & Karataş, S. (2018). Development and validation of perceptions of online interaction scale. *Interactive Learning Environments*, *26*(3), 337–354. https://doi.org/10.1080/10494820.2017.1333009

Bali, S., & Liu, M. C. (2018). Students' perceptions toward online learning and face-to-face learning courses. *Journal of Physics: Conference Series*, *1108*, 012094. https://doi.org/10.1088/1742-6596/1108/1/012094

Berg, G. Van Den. (2020). Context matters: Student experiences of interaction in open distance learning. *Turkish Online Journal of Distance Education*, 223–236. https://doi.org/10.17718/tojde.803411

Blanchette, J. (2012). Participant interaction in asynchronous learning environments: Evaluating interaction analysis methods. *Linguistics and Education*, *23*(1), 77–87. https://doi.org/10.1016/j.linged.2011.02.007

Cavinato, A. G., Hunter, R. A., Ott, L. S., & Robinson, J. K. (2021). Promoting student

interaction, engagement, and success in an online environment. *Analytical and Bioanalytical Chemistry*, *413*(6), 1513–1520. https://doi.org/10.1007/s00216-021-03178-x

Cetinkaya, L., & Keser, H. (2018). Adaptation of interaction in web environments with educational content. *World Journal on Educational Technology: Current Issues*, *10*(3), 142–152. https://doi.org/10.18844/wjet.v10i3.3555

Coskun, I., & Demirci, C. (2021). Distance education. In A. Kiray & E. Tomevska-Ilievska (Eds.), *Current Studies in Educational Disciplines 2021*. ISRES Publishin.

Creswell, J. W., & Poth, C. N. (2017). *Qualitative inquiry & research design: Choosing among five approaches*. SAGE Publications Inc.

Dubey, P., Pradhan, R. L., & Sahu, K. K. (2023). Underlying factors of student engagement to E-learning. *Journal of Research in Innovative Teaching & Learning*, *16*(1), 17–36. https://doi.org/10.1108/JRIT-09-2022-0058

Hillman, D. C. A., Willis, D. J., & Gunawardena, C. N. (1994). Learner-interface interaction in distance education: An extension of contemporary models and strategies for practitioners. *American Journal of Distance Education*, *8*(2), 30–42. https://doi.org/10.1080/08923649409526853

Hu, B. Y., Fan, X., Wu, Y., LoCasale-Crouch, J., & Song, Z. (2019). Contributions of teacher–child interaction quality to Chinese children's development in the early childhood years. *Early Education and Development*, *30*(2), 159–177. https://doi.org/10.1080/10409289.2018.1544809

Huang, C.-Q., Han, Z.-M., Li, M.-X., Jong, M. S., & Tsai, C.-C. (2019). Investigating students' interaction patterns and dynamic learning sentiments in online discussions. *Computers & Education*, *140*, 103589. https://doi.org/10.1016/j.compedu.2019.05.015

Huang, T. (2023). Factors affecting students' online courses learning behaviors. *Education and Information Technologies*, *28*(12), 16485–16507. https://doi.org/10.1007/s10639-023-11882-7

Jung, I., Choi, S., Lim, C., & Leem, J. (2002). Effects of different types of interaction on learning achievement, satisfaction and participation in web-based instruction. *Innovations in Education and Teaching International*, *39*(2), 153–162. https://doi.org/10.1080/14703290252934603

Kanuka, H. (2008). 4. Understanding e-learning technologies-in-practice through philosophies-in-practice. In T. Anderson (Ed.), *The Theory and Practice of Online Learning* (pp. 91–118). Athabasca University Press. https://doi.org/https://doi.org/10.15215/aupress/9781897425084.006

Karakara, A. A.-W., & Osabuohien, E. (2020). ICT adoption, competition and innovation of informal firms in West Africa: a comparative study of Ghana and Nigeria. *Journal of Enterprising Communities*, *14*(3), 397–414. https://doi.org/10.1108/JEC-03-2020-0022

Khlaif, Z., Nadiruzzaman, H., & Kwon, K. (2017). Types of interaction in online discussion forums: A case study. *Journal of Educational Issues*, *3*(1), 155. https://doi.org/10.5296/jei.v3i1.10975

Kokoç, M., & Altun, A. (2016). Building a learning experience: what do learners' online interaction data imply? *13th International Conference on Cognition and Exploratory Learning in Digital Age (CELDA 2016)*.

Lagat, K. T., & Concepcion, G. L. (2022). Students' social interaction, collaborative learning, and perceived learning in an online learning environment. *International Journal of Social Science Research and Review*, *5*(1), 24–33. https://doi.org/10.47814/ijssrr.v5i1.130

Mehall, S. (2020). Purposeful interpersonal interaction: What is it and how is it measured? *Online Learning*, *24*(1). https://doi.org/10.24059/olj.v24i1.2002

Miles, M. B., Saldana, A. J., & Huberman, M. (1994). *Qualitative data analysis: A methods sourcebook*. Sage Publication.

Miltiadou, M., & Savenye, W. C. (2003). Applying social cognitive constructs of motivation to enhance student success in online distance education. *AACE Review (Formerly AACE Journal)*, *11*(1). https://www.learntechlib.org/primary/p/17795/

Moore, M., & Kearsley, G. (n.d.). *Distance education: A systems view*. Wadsworth Cengage

Learning.

Muir, T., Milthorpe, N., Stone, C., Dyment, J., Freeman, E., & Hopwood, B. (2019). Chronicling engagement: Students' experience of online learning over time. *Distance Education*, *40*(2), 262–277. https://doi.org/10.1080/01587919.2019.1600367

Rivera Munoz, C. A., Baik, C., & Lodge, J. M. (2020). Teacher and student interactions in the first year of university. *Journal of Further and Higher Education*, *44*(8), 1130–1142. https://doi.org/10.1080/0309877X.2019.1664731

Schunk, D. H. (2012). *Learning theories: An educational Perspective*. Pearson Education Inc.

Schunk, D. H., & Usher, E. L. (2019). Social cognitive theory and motivation. In *The Oxford Handbook of Human Motivation*. Oxford University Press.

Simonson, M., Smaldino, S. E., Albright, M., & Zvacek, S. (2011). *Teaching and learning at a distance: Foundations of distance education*. Pearson.

Sun, J. C., & Rueda, R. (2012). Situational interest, computer self-efficacy and self-regulation: Their impact on student engagement in distance education. *British Journal of Educational Technology*, *43*(2), 191–204. https://doi.org/10.1111/j.1467-8535.2010.01157.x

Universitas Terbuka. (2023). *UT dalam angka*. https://www.ut.ac.id/ut-dalam-angka/

Vrasidas, C., & McIsaac, M. S. (1999). Factors influencing interaction in an online course. *American Journal of Distance Education*, *13*(3), 22–36. https://doi.org/10.1080/08923649909527033

Vygotsky, L. S. (1978). *Mind in Society* (M. Cole, V. Jolm-Steiner, S. Scribner, & E. Souberman (eds.)). Harvard University Press. https://doi.org/10.2307/j.ctvjf9vz4

Wan Husssin, W. T. T., Harun, J., & A Shukor, N. (2019). Online interaction in social learning environment towards critical thinking skill: A framework. *Journal of Technology and Science Education*, *9*(1), 4. https://doi.org/10.3926/jotse.544

Wang, P. (2023). Effects of different educational interaction modes on students' independent online learning ability. *International Journal of Emerging Technologies in Learning (IJET)*, *18*(18), 76–87. https://doi.org/10.3991/ijet.v18i18.42531

Woo, Y., & Reeves, T. C. (2007). Meaningful interaction in web-based learning: A social constructivist interpretation. *The Internet and Higher Education*, *10*(1), 15–25. https://doi.org/10.1016/j.iheduc.2006.10.005

Yin, R. K. (2016). *Qualitative research from start to finish*. The Guilford Press.

York, C. S., & Richardson, J. C. (2012). Interpersonal interaction in online learning: experienced online instructors' perceptions of influencing factors. *Journal of Asynchronous Learning Networks*, *16*(4). https://files.eric.ed.gov/fulltext/EJ982684.pdf