Relationship between Synchronous and Asynchronous Online Learning and Chemistry Students' Engagement

Cecilia Obi Nja, Ph.D
conja@unical.edu.ng
Department of Physical Science Education
Faculty of Science Education
University of Calabar, Calabar

Sanda Francis Ademola, Ph.D
osarosowo@gmail.com
Department of Curriculum and Teaching
Faculty of Educational Foundation Studies
University of Calabar, Calabar

Oyovwikoghene Sunday
osowoachot@gmail.com
Department of Science Education
Faculty of Vocational and Science Education
University of Calabar, Calabar

Abstract

The study examined the relationship between synchronous and asynchronous online learning and chemistry students' engagement. The study utilized two hypotheses. The survey research design was used in this study. A questionnaire titled "Influence of Online Learning on Student Engagement Questionnaire" (IOLSEQ) was used as the instrument for data collection. The sample included 200 randomly selected students from the Science Education department of the University of Calabar. Analysis done using the Pearson Product Moment Correlation Coefficient at 0.05 level of significance revealed that synchronous and asynchronous online learning significantly relate to students' engagement. Recommendations include promoting awareness on the benefits of online learning, educating students on proper device use, and providing the necessary facilities and training for effective implementation.

Keywords: synchronous, asynchronous, online, learning, students

Introduction

Chemistry is the scientific discipline that studies the composition, properties and behaviour of matter, as well as the changes it undergoes during chemical reactions. It is commonly referred to as the "Central Science" since it links different fields of study, such

as physics, biology, geology, and environmental science (Nja et al., 2023). Chemistry seeks to understand the nature of matter at the atomic and molecular levels. It explores the interactions and changes that occur between different substances and the underlying principles governing those processes. Chemistry finds application in various specialized areas like medicine, food production, chemical engineering and manufacturing, cosmetics and personal care products, and so on (Nja et al., 2024). To truly unlock the potential of this subject, it is essential to foster students' engagement, where students actively participate, connect with the material, and develop a deep appreciation for the wonders of chemistry (Hattie, 2009).

Student engagement is a multifaceted construct that refers to the level of involvement and investment that students have in their learning (Fredricks et al., 2004). Engaged students are active learners who demonstrate a strong interest in learning and a willingness to put forth effort to achieve academic success. They are motivated to learn, often demonstrating a sense of excitement and enthusiasm about their studies. Fredricks et al. (2004) state that there are three dimensions of students' engagement: behavioural, emotional, and cognitive.

Despite the importance of students' engagement, there are several problems that can impede students' ability to become engaged in their learning process. With the rise of technology and social media, students may become distracted by their smart phones, laptops, and other devices, which can interfere with their ability to engage with course material (Clifford, 2010). Other factors that may that affect students' engagement include perception of learning having no direct relevance to their lives, interests, or future goals (Deci & Vallerand, 1991; Smith, 2020); lack of wide range of available courses for students to choose from (Reeve, 2006); and negative classroom climate (Rimm-Kaufman et al., 2015).

Online learning has the potential to increase students' engagement (Means et al., 2013). Through the use of the internet, students can access course materials, communicate with instructor, and work together with peers in an environment known as online learning. Online learning includes interactive, synchronous, asynchronous, and adaptive. This study is focused on synchronous and asynchronous types of online learning.

Synchronous online learning refers to a mode of online education in which students and instructors participate in learning activities simultaneously, in real-time, but from different locations. This approach often involves live lectures, discussions, and other interactive elements conducted through web conferencing tools or virtual classrooms (Smith, 2020).

Synchronous online learning provides learners with immediate feedback and support, allowing them to ask questions and clarify concepts in real-time. This can be particularly useful in complex or technical subjects, where learners may need more guidance and support from their instructors. Interaction between students is another benefit of synchronous online learning. Their speech tones and facial expressions can help them feel more human across a wider range and facilitate low-cost international communication. Anderson et al. (2010), Garrison and Kanuka (2004) reported that synchronous online sessions encouraged more contact between students, which raised involvement and engagement.

Research has shown that educational results can be effectively promoted by synchronous online learning, especially when it is paired with other online learning formats like blended learning and asynchronous online learning. Means et al. (2013) conducted a meta-analysis and discovered that synchronous online learning improved learning outcomes in a minor but meaningful way, especially when paired with asynchronous learning activities. Garrison (2007), and Rovai and Jordan (2004) highlighted that synchronous online learning cultivates a sense of community and social presence, contributing to higher levels of engagement and satisfaction. However, technical issues, such as internet connectivity and software compatibility, can impact the effectiveness of synchronous learning activities (Hrastinski, 2008b).

Asynchronous online learning, on the other hand, refers to a mode of online education in which students and instructors do not need to participate in learning activities simultaneously. Instead, students possess the freedom to access course materials and finish assignment at whatever time they choose (Brown, 2019). This approach allows for greater flexibility and convenience, as students can fit their studies around work, family, or other obligations. Asynchronous communication environments give students access to discussions and conferences where they can participate at different times. Because of this flexibility, students can work whenever and wherever they choose, giving them more time to consider their own ideas and inspiring them to engage in more critical thinking. Asynchronous online learning, like traditional distance education, stresses flexibility in the classroom by allowing participants to learn at their own pace. It is typically assisted by emails and discussion boards (Hrastinski, 2008a).

Asynchronous students and teachers can still communicate with one another over the phone, through emails, and through discussion boards (Hrastinski, 2008a). Students enrolled in asynchronous courses are deprived of the opportunity to ask questions in order to enhance their comprehension and assimilation of the material. Email and discussion boards are used to assist asynchronous learners (Jackson, 2010). The ability to access their

course and finish assignments at their own pace is advantageous for asynchronous learners (Hrastinski, 2018a; Olson & McCracken, 2015). Compared to the more inflexible synchronous course structure, it is far more adaptable. According to Rodríguez-Manzanares and Barbour (2011), learning in an asynchronous environment is autonomous, self-paced, and student-centred. The distance mode lessens shyness by alleviating teacher-related anxiety. Anderson et al. (2010), and Coogle and Floyd (2015) stated that asynchronous online learning allows students to engage with course materials at their own pace and convenience, promoting self-regulated learning and autonomy. According to Huang and Hsiao (2012), delayed input can be a source of frustration. Students must find their own means of networking because there are not enough possibilities for blending.

This study is anchored on Self-determination theory of Deci and Ryan (1985). Self-determination theory posits that human beings have innate psychological needs for autonomy, competence and relatedness. Autonomy involves having a sense of volition and personal choice in one's actions. It recognizes the importance of individuals feeling a sense of control and ownership over their behaviours and decisions. It suggests that when individuals' psychological needs for autonomy, competence, and relatedness are met, they are more likely to experience enhanced engagement, motivation and well-being. In the context of online learning, this theory suggests that students' engagement and motivation can be fostered by providing them with opportunities to exercise choice, develop their skills and knowledge, and connect with others.

Statement of the problem

The ideal situation for students' engagement is one where students are actively involved in their learning and feel a sense of ownership and responsibility for their education. According to a study by National Survey of Student Engagement, "engaged students demonstrate a heightened level of motivation, persistence and cognitive investment in learning. They are more likely to achieve academic success and less likely to drop out of college" (NSSE, 2020). In the present situation, with the challenge of less students' engagement, it is important to find ways to keep students engaged and motivated. This study therefore sought to find out students' engagement in a synchronous and asynchronous online learning.

Hypotheses

Two null hypotheses were stated to guide the study:

Ho1: Synchronous online learning has no significant relationship with students' engagement.

Ho2: Asynchronous online learning has no significant relationship with students' engagement.

Methodology

The research employed a correlational research design. The participants comprised all students enrolled in the Science Education Department of the University of Calabar, with a population of 998 students. The study used a simple random sampling strategy to arrive at a sample size of 200.

The instruments used for data collection was titled "Influence of Online Learning on Students Engagement Questionnaire" (IOLSEQ). The questionnaire essentially comprised of fifteen items using 4-points Likert-style scale to measure the relationship between synchronous online learning and asynchronous online learning, and students'engagement. IOLSEQ was made up of two sections, section A and section B. Section A measured students' demographic variables like gender and age. Section B measured the variables of synchronous and asynchronous online learning and also students' engagement variable. All the variables had 5 items each, making a total of 15items. The respondents were required to indicate their options from Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD). The scoring for positively worded items included SA= 4 points, A= 3 points, D = 2 points, SD = 1 point. However, the scoring was reversed for negatively worded items. Face validity was conducted for the instrument. Cronbach alpha reliability method was employed to establish the reliability of the instrument. The reliability coefficients obtained ranged from 0.64 to 0.83. The questionnaire was administered online to 200 students. Pearson Product Moment Correlation was the method used for analysis.

Presentation of results

Ho1: Synchronous online learning has no significant relationship with students' engagement.

Table 1: Mean, standard deviation and Pearson Product Moment Correlation results of synchronous online learning and students' engagement

	Descriptive Statistics		
	Mean	**Std. Deviation**	**N**
Synchchronous	13.23	2.749	200
Engagement	14.42	3.845	200
	Correlations		
		Synchronous	**Engagement**

Synchronous	Pearson Correlation	1	.178*
	Sig. (2-tailed)		.011
	N	200	200
Engagement	Pearson Correlation	.178*	1
	Sig. (2-tailed)	.011	
	N	200	200

*(p<.05) Df =198

Table 1 indicates that the computed r-value at 198 degree of freedom is .178, and the p-value at the 0.05 threshold of significance is .011. Since the p-value of .011 is less than the significant level of .05 (p<.05), the null hypothesis is rejected. These suggest that students' engagement is significantly correlated with synchronous online learning.

Ho2: Asynchronous online learning has no significant relationship with students' engagement.

Table 2. Mean, standard deviation and Pearson Product Moment Correlation results of Asynchronous online learning on students' engagement

Descriptive Statistics			
	Mean	**Std. Deviation**	**N**
Engagement	14.42	3.845	200
Asynchronous	11.99	2.598	200

Correlations			
		Engagement	**Asynchronous**
Engagement	Pearson Correlation	1	.251**
	Sig. (2-tailed)		.000
	N	200	200
Asynchronous	Pearson Correlation	.251**	1
	Sig. (2-tailed)	.000	
	N	200	200

*(p <05) Df =198

Results as displayed in Table 2, indicate that the computed r-value at 198 degree of freedom is .251, and the p-value at the 0.05 significant level is .000 (p<.05). The null hypothesis is rejected.

Discussion of the findings

The result from the testing of Hypothesis 1 indicated that there is a significant relationship between synchronous online learning and students' engagement. Synchronous online learning involves real-time interactions between students and instructors through video conferencing or live chat platforms. The Instant feedback loop during synchronous sessions enhances understanding and motivation. Structured schedules of synchronous classes help students establish routines, leading to better time management and commitment to learning. Active participation is encouraged as students feel accountable to peers and instructors, contributing to better comprehension and retention. These results are consistent with studies conducted by Anderson et al. (2010), Garrison and Kanuka (2004). They reported that synchronous online sessions encouraged more contact between students, which raised involvement and engagement. In a similar vein, studies by Garrison (2007), and Rovai and Jordan (2004), highlighted that synchronous online learning cultivates a sense of community and social presence, contributing to higher levels of engagement and satisfaction.

The outcome of testing the second hypothesis showed that asynchronous online learning has a significant relationship with students' engagement. One of the primary advantages of asynchronous online learning is the flexibility it affords students. This autonomy allows them to choose when and where they engage with course materials, enabling them to better juggle academic commitments with other responsibilities. This sense of control often results in increased engagement as students feel more empowered in their learning journey. Furthermore, asynchronous learning contributes to accessibility and inclusivity. It accommodates students with disabilities, those in different time zones, and individuals with work or family commitments. This inclusiveness can contribute to higher engagement levels among a wider range of students. The finding agreed with Anderson et al. (2010), and Coogle and Floyd (2015) who stated that asynchronous online learning allows students to engage with course materials at their own pace and convenience, promoting self-regulated learning and autonomy. This flexibility can lead to increased engagement as students can tailor their learning experience to their individual preferences and schedules.

Conclusion

The study's findings led to the conclusion that synchronous and asynchronous online learning significantly relate to students' engagement.

Recommendations

The study's findings led to the following recommendations being made:

1 It is necessary that educators should raise awareness on the benefits of using online learning for teaching and learning.

2 To improve the learning objective, curriculum developers and the government should implement and promote the use of online learning for teaching and learning in all departments.

3 Lecturers should be encouraged and educated on enhancing learning quality through the use of online learning.

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