A comparison of the level of the ESP language learners' performance and engagement in a synchronous online course and the face-to-face course

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ABSTRACT: Evidence is steadily mounting on the prominence of online and technology-enabled learning in higher education. The present study intended to investigate whether virtual, interactive, real-time, instructor-led (VIRI) online learning has the potential to yield comparable student performance and engagement results to that of a traditional face-to-face (F2F) course. This is of great significance since the study delves into the possibilities of synchronous online learning in environments where resources are scarce and provide valuable insights into how technology can contribute to improving medical education and accessibility to educational resources in Iran and other comparable educational contexts. The participants were 18–30-year-old male (n = 16) and female (n = 24) students of nursing (n = 20) and operating room (n = 20) who enrolled in synchronous online and face-to-face courses as the requisite for the fulfilment of a bachelor's degree. T-tests and descriptive statistics were the study employed T-tests and descriptive statistics to assess variations in both student performance and engagement results. The results revealed that a synchronous course conducted through VIRI classroom technology yields equivalent student performance outcomes to a traditional face-to-face (F2F) learning environment. The findings further showed that while the students did not appear to differ in terms of the levels of expected interest in the course and paying attention in class for the F2F and VIRI courses, they perceived themselves as displaying a different behaviour in the two courses in terms of attending class, participating in class, academic workload and instructor interactions. In fact, the post-semester findings showed that despite the students' earlier expectations, they displayed different behaviour on all six student engagement factors. The findings of this study could have direct implications for the creation, development, and delivery of synchronous online courses in higher education, including medical ones.

KEYWORDS: synchronous online learning; virtual; interactive; real-time; instructor-led; learning

1. Introduction

The popularity of online learning has been increasing gradually and is expected to continue to increase in the coming years (Croxton, 2014; Richardson et al., 2017; Linton, 2013). The prominence of online learning has been even more pronounced in 2020 with the spread of the COVID-19 pandemic (Ali, 2020). As a teaching method highly affected by the so-called innovative technological revolution, online learning has witnessed a drastic shift in Iran in the past years, and synchronous online learning has been increasingly adopted by higher education institutes, including medical ones. Online learning offers various benefits, such as flexibility in participation, convenience, and customisation to learners' needs, as Croxton (2014) and Richardson et al. (2017) noted.

Learners can access online courses through user-friendly programs installed on their smartphones, computers, or laptops, making it possible to take courses from convenient locations and reducing time and place constraints (Francescucci and Rohani, 2019). Synchronous online learning enables students to interact with other students and teachers in real-time (Francescucci and Rohani, 2019; Watts, 2016; Giesbers et al., 2014; etc.). Using synchronous environments, such as Adobe Connect, instructors can group students to discuss specific topics or complete learning tasks, replicating a face-to-face classroom environment. However, the lack of face-to-face interactions between students and instructors or among students remains a significant concern in online learning.

Given the prominence attached to the effectiveness of synchronous environments and their impact on educational outcomes, this study intends to see whether the use of an entirely virtual, interactive, real-time, and instructor-led (VIRI) online learning environment can deliver the same student performance and engagement outcomes as a F2F learning environment. The present study intended to investigate the effect of a synchronous online course on student learning outcomes and their level of engagement compared with a F2F approach among Iranian English for Specific Purposes (ESP) language learners in medical education contexts. What sets this study apart from previous research is its focus on synchronous online learning in areas with limited educational infrastructure, specifically among nursing and operating room (students intending to become operations room professional) students. Given the scarcity of research on this topic in the Iranian medical education context, this is a critical area of research. By exploring the potential of synchronous online learning in contexts with limited resources, this study offers valuable insights into technology's role in enhancing medical education and improving access to educational resources in Iran and similar educational contexts.

2. Literature review

Earlier research has pointed to the students' positive perception of synchronous online interactions and considered them a cause for increased engagement, collaboration and exchanges in an online learning environment (Falloon, 2011; Herastinski, 2008; Strang, 2013; etc.). Synchronous online learning has also been found to motivate students to interact and participate in group work (Herastinski, 2008). Despite some misconceptions, face-to-face and online education are similar in that they both require providing course content-related communications, planning of tasks, and social support for collaborative learning (Haythornthwaite, 2002; Herastinski, 2008). In the same way, synchronous online learning has been found to improve the learning experience, test performance motivation, cognitive retention, cognitive engagement and overall course grades (Duncan et al., 2012; Giesbers et al., 2014; Haythornthwaite, 2002; etc.). Other studies have pointed to the students' preference to enrol in online classes for individual tasks (Krasnova and Vanushin, 2016). As an instructional approach which combines technology and a face-to-face teaching environment (Poon, 2013; Torrisi-Steele and Drew,

2013; Ahmed and Abdu, 2021; etc.), investigation of the degree that the students engage in a blended learning course using VIRI classroom technology, how they perform and whether they are satisfied has shown that the VIRI course may increase the level of engagement by capturing features from both online and face-to-face instruction (Francescucci and Foster, 2013).

Many studies have compared online and face-to-face classroom learning (Francescucci and Rohani, 2019). Opinion is, however, diverged on online education's impact on student engagement and performance. While some research has pointed to the non-significant link between students' performance and engagement with the course delivery mode (Francescucci and Foster, 2013; Hansen, 2008; McLaren, 2004), online course delivery is more effective than traditional course delivery in terms of developing skills in experiential studies where application of knowledge to real-world projects is required (Cavanaugh and Jacquemin, 2015) Moreover, learners with higher previous grade point averages have been found to perform better in online settings than face-to-face educational contexts (Jaggars et al., 2013). Another line of research has investigated the possible negative impacts of online or face-to-face learning on learning objectives and student grades (Jaggars et al., 2013; Ramani and Deo, 2020; Xu and Jaggars, 2014).

Generally speaking, the findings of studies which address the effectiveness of online learning contexts and face-to-face classes show mixed results. While most of these studies have compared learners' performance and engagement in virtual and face-to-face settings conducted by one or more teachers, they are limited to asynchronous online learning contexts. Hence, there is a crucial need to address these issues in synchronous online educational settings (Chaw et al., 2023). Concerning the growing attention towards the effectiveness of online learning and its impact on student performance and learning experience, the intend of the present study was to see if the students who have enrolled in a synchronous online class differ from those participating in a face-to-face classroom in terms of classroom engagement and performance.

3. Objectives and research questions

The present study intends to expand the line of research on online education by assessing the efficacy of such approaches compared to conventional face-to-face learning. Therefore, this study will investigate whether a synchronous online course delivers the same student performance and engagement outcomes as a face-to-face one. The objectives mentioned above are formulated into the following research questions:

Is the students' level of performance in a synchronous online course similar to their performance in a face-to-face course?

Is the students' level of engagement in a synchronous online course similar to their engagement in a face-to-face course?

4. Method

4.1. Design of the study

The study adopted a quasi-experimental design to assess the level of student performance and engagement of a group of students who participated in ESP synchronous online and face-to-face courses as the requirement for receiving a BA degree at Larestan University of Medical Sciences in the winter semester of 2021–2022. The courses attended by the participants were two unit compulsory English courses as a prerequisite for fulfilling a BA degree.

4.2. Participants

The participants were 18–30-year-old male (n = 16) and female (n = 24) students of nursing (n = 20) and operating room (students intending to become operations room professiona) (n = 20) who enrolled in the English courses as a requisite for the fulfilment of a BA degree. They were assigned to the sections of the ESP courses by the educational affairs office based on their field of study. The students whose field of study was operating room (students intending to become operating room professionals) were put into one class and the students whose field of study was nursing were put into one class. The reason for doing this is that the administrative office does not allow mixing students with different fields of study in English courses.

Purposive sampling was used to rule out instruction effects. To this end, both of the classes were taught by the same teacher (a single teacher taught both classes). The participants in both classes were taught by the same teacher using face-to-face and synchronous online learning modes in successive manner. In other words, the operations room professionals and nursing ESP classes were divided into two parts. First, the students in both classes were instructed using face-to-face learning for two weeks and then they were instructed using synchronous online learning for two weeks. Non-volunteers or students who were reluctant to participate were excluded. Caution was exercised to include students with similar levels of language proficiency. Therefore, the participants' marks for their general English language course in the previous semester were obtained from the educational affairs office.

4.3. Instruments

4.3.1. The engagement questionnaires

The study used six-item, five-point Likert-scale pre- and post-engagement questionnaires developed by Francescucci and Foster (2019) to measure levels of student engagement. The instruments have been adapted from the National Survey of Student Engagement. Back translation by two experts and factor analysis were used to ensure the validity of the questionnaire items. The presence of many coefficients of 0.3 and above in the correlation matrix, the Kaiser-Meyer-Oklin value for the pre- and post-engagement questionnaires being higher than 0.6 and Bartlett's Test of Sphercity being significant (P = 0.000) pointed to the factorability of the correlation matrix and the validity of the pre- and post-engagement questionnaires. As mentioned above, the questionnaires' reliability was assessed by Cronbach Alpha. The reliability coefficients for the post-engagement and pre-engagement questionnaires were 0.75 and 0.74, respectively.

4.3.2. The online and face-to-face exams

The study also used two multiple-choice online and face-to-face exams to measure the students' performance in the F2F and VIRI classes. The exam which was given at the end of the online courses was conducted electronically via the Sejab platform (http://exam.larums.ac.ir/). It is an officially renowned accredited platform for conducting online electronic multiple-choice tests and exams across Iranian medical universities. The exam given at the end of the F2F instruction was in the form of paper and pencil. Since the participants were from different majors, a separate exam was conducted for each group. The online and paper and pencil exams were conducted in a controlled setting in a closed book environment to remove the impact of cheating on the students' scores. The reliability, validity and difficulty level of the exams were checked. It was illuminated that the tests have satisfied the reliability, validity and difficulty indexes.

The online exam for the students of operating room (students intending to become operations

room professiona) included 20 items. The items addressed vocabulary ($n = 10$), word forms ($n = 6$), true or false ($n = 2$) and reading comprehension ($n = 2$). Likewise, the online exam for the students of nursing included 20 items. The items addressed vocabulary ($n = 13$), word forms ($n = 5$), true or false ($n = 1$) and reading comprehension ($n = 1$). The exams conducted at the end of the F2F instruction were in paper and pencil format. The exam for the students of operating room (students intending to become operations room professiona) included 20 multiple-choice items on vocabulary ($n = 10$), word forms ($n = 5$), true or false ($n = 1$), reading comprehension ($n = 1$) and multiple choice (MC) cloze test ($n = 3$) and for the tests for the students of nursing consisted of 25 MC items on vocabulary ($n = 12$), word forms ($n = 6$), true or false ($n = 2$), reading comprehension ($n = 1$) and multiple choice cloze test ($n = 4$).

4.4. Instruction

4.4.1. Instruction in the online courses

The students in the online sessions joined the sessions on the pre-specified date and time via Adobe Connect through a registered username and password, which had been assigned to them by the educational affairs office. At the beginning of each session, the instructor greeted the students and responded to their comments in the chat box. Then the students were orally asked if they wanted to ask questions about the material presented in the previous session. The session then proceeded with the instructor giving a summary of the content that had been presented in the previous session. Meanwhile, questions were posed to assess the level of the students' understanding and involve them in the teaching-learning process. The session would then unfold with the instructor screen sharing and presenting the intended content. PowerPoints, video clips and online search accompanied the instructor's teaching.

The instructor also used the platform's tools (i.e., pen, highlighter, etc.) to note specific points or draw the students' attention to important points. Another feature of Adobe Connect is video connection. Because of connectivity issues and poor internet connection, the teacher was unable to use Adobe Connect webcam often (during screen sharing, the connection is lost if the webcam is on). However, once in a while, the instructor activated his webcam to establish eye contact and draw the students attention and build rapport. The teacher also asked the students to turn on their webcams sporadically to build rapport with them. The instructor ensured that the students were attentive by posing questions and asking the students to respond orally. The students could pose questions by typing them in the chat box or hand rising. Each online session was recorded and uploaded to Navid (https://larumsnavid.vums.ac.ir/) after the class. Navid is an online learning platform which Iranian medical universities use. Accessing Navid requires the student's ID number and the self-created password. The session would end with the teacher concluding on the presented material, specifying homework and discussing the topic(s) presented in the next session. Checking the students' comprehension by asking and responding to their questions was also evident at the end of the class. The instructor checked for absentees by using Adobe Connect features.

4.4.2. Instruction in the face-to-face classes

The students attended the face-to-face sessions on the time and date specified by the educational affairs office. Like the online sessions the instructor greeted the students at the beginning of the class and asked how they were doing/feeling. He made short compliments to some of them. After assuring that the students had understood the material presented in the previous session by asking questions, the instructor continued his teaching by drawing the students' attention to the key points of the material presented in the previous session. Meanwhile, he encouraged the students to ask questions if they had

encountered difficulties while studying the previous material. The content for the intended session was then presented in PowerPoint. The students attentively listened to the teacher and took notes. Once in a while, the instructor stopped teaching and tried to involve the students in the teaching/learning process by asking questions. The students could not leave the class during the instructor's teaching. Eating and drinking were also prohibited. A ten-minute break was given in each session. The class ended by checking the students' comprehension by asking questions, responding to possible questions, giving a conclusion on the presented material, specifying homework, discussing the topic(s) that would be presented in the next session and checking for the absentees.

4.5. Course content

The course content for English for nursing students and operation room students is taught through two books authored by ESP faculty members at Shiraz University of Medical Sciences. Before publication, each book undergoes a rigorous peer review, editing, and certification process to ensure its quality and effectiveness. The English for nursing students book is structured into units, with each unit comprising three sections. These include a video comprehension section, a reading comprehension section with true or false questions, vocabulary and word form exercises, a matching exercise, and a cloze test. The book also features a self-study section with nursing vocabulary exercises to enhance students' learning experience.

Similarly, the English for operation room students book has a comparable structure and format. It comprises a main reading section and a further reading section, which includes true or false questions, reading comprehension exercises, vocabulary and word form exercises, and a cloze practice exercise. Using this format, the book aims to provide students with a comprehensive learning experience catering to their needs as operation room professionals.

4.6. Data collection

The data collection was completed in several phases. In the first phase, the link to the online pre-engagement questionnaire was sent to the participants via WhatsApp (https://www.whatsapp.com/) before they attended the face-to-face sessions. The participants were instructed to complete the questionnaire no later than the beginning of the face-to-face sessions. Then, the students in both classes received face-to-face instruction for two weeks. Each face-to-face session was 90 min. The students attended the F2F sessions three times a week. At the end of the F2F sessions, the link to the online post-engagement questionnaire was sent to the participants via WhatsApp with instructions to complete it before the beginning of the online sessions.

The second data collection phase consisted of giving an exam at the end of the face-to-face sessions. The exam marked the end of the face-to-face sessions. In the third phase of data collection, the participants were required to complete the online pre-engagement questionnaire, which was sent to them by WhatsApp before the beginning of the online sessions. Then, the synchronous online classes were conducted for two weeks via Adobe Connect. Each online session was 90 min. The students attended the online sessions 3 times a week. After two weeks, the link to the post-engagement questionnaire was sent to the participants via WhatsApp. At the end of the online sessions, an online exam (electronic test) was given to assess the students' ESP performance level.

4.7. Statistical analysis

The study employed T-tests and descriptive statistics to compare the pre-and post-semester means for student engagement and student performance outcomes. Factor analysis and Cronbach Alpha were

used to determine the validity and reliability of the questionnaires, respectively.

5. Results and discussion

5.1. Performance

The findings for the first research question, which compared the students' performance in an online and face-to-face course, indicated that they had the same level of performance in the two courses as measured by the paper-pencil and online exams (**Table 1**). This suggests that a VIRI language course can result in the same level of performance as in a F2F ESP class. The findings here correlate with the findings of earlier research that point out that different course delivery modes of online and F2F do not affect student's performance (Francescucci and Rohani, 2019, p. 37; McLaren, 2004; Francescucci and Foster, 2013; etc.). These are significant findings since they extend the line of research on online teaching in that they show that a synchronous online learning context may create an educational setting which closely resembles a face-to-face learning context in terms of learner performance (Francescucci and Rohani, 2019).

Table 1. T-test of student performance outcomes.

Online exam means			F2F exam means			
Mean	**SD**	***n***	**Mean**	**SD**	***n***	***p* value**
15.17	3.05	40	15.62	2.64	40	0.458

The fact that in the present study, the students' performance in a synchronous online learning context was similar to the performance of the students in a face-to-face learning context implies that other variables apart from the delivery mode may have accounted for the students' equal inclination for the two learning contexts. A plausible assumption could therefore be that although online and face-to-face learning environments may differ in their delivery modes, learning activities, class interactions, assessment approaches, etc. (i.e., Chaw et al., 2023), tailoring the learning design to factors such as the characteristics of learners, student learning needs, learning capabilities, and learning gap, etc. (Gordon et al., 2010) in a learning context can impact the learners' academic performance (Geremew and Abdissa Gurmesa, 2015; Getachew, 2018). In other words, both virtual (VIRI) and face-to-face (F2F) delivery modes possess the potential to foster successful learning environments when skillfully taught and when their distinct characteristics are effectively leveraged by the instructor. This statement underscores the importance of instructional quality and the alignment of teaching strategies with the unique attributes of each delivery mode.

Some research is indicative that there are no differences in teacher knowledge and beliefs, teacher classroom practice, and student learning outcomes in F2F and VIRI classes (Fishman et al., 2013). Another good evidence for this is a blended learning context in which some of the student characteristics/backgrounds and design features are significant predictors for student learning outcomes (Kintu et al., 2017; Lapitan et al., 2021).

Besides other factor, the crux of establishing effective learning environments does not exclusively depend on the selection of delivery methods, but rather on the pedagogical proficiency of the instructor and their capacity to optimize the advantages and address the difficulties connected with VIRI and F2F modes. The efficacy of each instructional mode ultimately hinges on the instructor's ability to fit their pedagogical approaches with the unique characteristics and potentialities of that mode.

5.2. Engagement

The present study also addressed the levels of student engagement for the students receiving online and F2F instruction. Student expectations (predictions) and actual experiences of attending class, participating in class, interest in the course, paying attention in class, academic workload, and instructor interactions constituted the student engagement factors in this study. **Table 2** illustrates the engagement level measures and the T-test *p* values for the students before and after receiving F2F and VIRI instruction. Unlike the results for student performance levels, there were differences in the student engagement levels among the same cohort when exposed to both face-to-face (F2F) and VIRI instruction. In other words, the students engagement level while receiving face-to-face instruction was different from their engagement level when they were taught using VIRI.

Table 2. T-test of student engagement outcomes.

	Pre-semester means			Post-semester means		
	n = 40	*n* = 40		*n* = 40	*n* = 40	
Engagement outcomes	**F2F**	**VIRI**	*p* value	**F2F**	**VIRI**	*p* value
Attendance	4.75	4.35	0.028	3.80	3.15	0.041
Participation	4.02	3.72	0.027	4.17	3.22	0.000
Interest	3.67	3.95	0.195	3.77	3.35	0.061
Attention	4.05	4.27	0.107	3.42	2.77	0.010
A_workload	4.37	4.00	0.050	4.27	3.40	0.003
Ins_interaction	3.60	3.15	0.012	4.27	2.70	0.000

Table 2 indicates that while the students did not appear to differ in terms of the levels of expected interest in the course and paying attention in class in the F2F and VIRI learning modes, they expected themselves to display a different behaviour in the two modes of instruction in terms of attending class, participating in class, academic workload and instructor interactions. In other words, the students did not expect their interest in the course and the level of paying attention in the class to differ from the face-to-face to VIRI learning modes. However, they expected that class attendance, class participation, the academic workload and the amount of teacher interactions would be different in the F2F and VIRI sessions.

The post-semester engagement findings obtained from completing the post-engagement questionnaires further showed that despite the students' previous expectations, they displayed different behaviour on all six student engagement factors. Put otherwise, despite their previous expectations (before attending the F2F and VIRI sessions), the findings showed that the students interest in the course was different in the F2F and VIRI sessions. Moreover, the students specified that paying attention in class, class attendance, class participation, the academic workload and the amount of teacher interactions were different in the F2F and VIRI sessions.

The pre-semester means further pointed out that the students expected lower attendance and participation levels in the VIRI instruction mode. They also expected to experience a lower workload and confront less teacher-student interactions in the VIRI sessions. In line with this expectation, the findings show that the post-semester VIRI means for the engagement factors were lower than the post-semester F2F means. This suggests that the students had a higher attendance, participation, interest and attention level when they were instructed using F2F mode. It also indicates that workload and instructor interaction were less in the VIRI sessions.

The results of the present study in terms of student engagement are contrary to Butts et al. (2013) and Abuatiq et al. (2017) who concluded that the students did not differ in terms of how they perceived engagement in online and face-to-face learning modes. Unlike Butts et al. (2013), May (2019) examined students' effectiveness and perceived engagement in virtual and F2F classes and stated that the learners differed in their withdrawal and attendance rates. In another study by Watts (2016), verbal exchanges in an online learning context were shown to improve the level of the students' engagement, allowing instant feedback and interaction (Falloon, 2011; Herastinski, 2008; Strang, 2013; etc.).

Unlike the student performance outcomes, the results for the student engagement factors were mixed. It is evident that where differences between the learners in engagement exist, the students enrolling in face-to-face classes were more engaged than those involved in online ones. Except for two cases that were not statistically significant, the face-to-face (F2F) learners tended to show a higher level of engagement at the beginning and end of the face-to-face instruction. This finding is important because it contradicts previous research suggesting engagement influences students' academic performance outcomes. The results of this study indicate that this is not the case for VIRI (Virtual Interactive Real-Time Instruction) learning. These findings align with a previous study by Francescucci and Foster (2019), who found no differences in student performance outcomes between the VIRI and F2F groups but higher levels of engagement with the latter group.

The present study's findings contradict some literature on performance and engagement, which suggests that the impact of engagement in a learning course on student performance remains unsettled (Francescucci and Foster, 2013). This highlights the need for further studies on student engagement in face-to-face and online learning approaches. Additionally, it could imply that although face-to-face learning is often associated with higher levels of student engagement, students' performance in a virtual online environment does not appear to be affected by lower levels of engagement (Francescucci and Rohani, 2019).

The finding that student engagement tends to be lower in online classes compared to face-to-face classes in the present study can be attributed to several key factors. One significant factor is the absence of physical presence in online learning environments (Taqizade and Hatami, 2019). In face-to-face classes, students and instructors share a physical space, fostering a sense of community and accountability. This physical presence often leads to more spontaneous social interactions, both within and outside the classroom, which can enhance engagement. Moreover, the structured schedule of face-to-face classes, with regular in-person meetings, helps establish a routine that keeps students on track and engaged. However, online classes, lacking this physical presence and structure, can make it easier for students to disengage, especially if they struggle with self-motivation or discipline. Additionally, the need for technology access and a stable internet connection (there are severe connectivity issues in Iran) can pose barriers (Konuralp and Topping, 2023) to engagement for some students, further contributing to the observed differences.

Furthermore, the design and quality of online courses play a crucial role in student engagement (Garrels and Zemliansky, 2022) Poorly designed online courses with limited interactive elements can hinder engagement levels. Effective course design, including clear objectives, engaging content, and opportunities for interaction, can mitigate some of the engagement challenges in online learning. It's worth noting that individual learning styles and preferences also come into play (Jones and Blankenship, 2017; Gacusan et al., 2023) with some students thriving in online environments, while others find face-to-face classes more engaging. Addressing the issue of lower engagement in online classes requires a comprehensive approach that considers these multifaceted factors and focuses on improving the

quality of online education to make it more engaging and effective for all students/learners.

6. Conclusion

Online learning is gaining recognition due to its flexibility, convenience, and potential for customisation to meet learners' needs. However, it remains unclear whether synchronous online learning provides the same quality of education as face-to-face instruction. This study investigated whether student performance and engagement levels in synchronous online learning were comparable to face-to-face courses. The study's findings are consistent with some existing literature, suggesting no significant disparity in student performance between various course formats. Prior research has also indicated that properly designed VRI courses can be as effective as traditional in-person courses in achieving academic goals.

The observed differences in how students perceive their behaviours in terms of participation, class attendance, workload management, and interactions with instructors align with the notion that student engagement can differ based on the instructional mode. Online courses might necessitate distinct self-regulation and interaction approaches, leading to these divergences in perceived behaviours. The contrast between students' initial expectations and their actual conduct concerning engagement factors, observed after enrolling in F2F and VRI sessions, is captivating. This phenomenon could stem from a shift in students' perceptions due to their direct experiences during the course. It emphasises the significance of firsthand experiences and the potential for initial expectations to be transformed based on real-life encounters. These findings contribute to the broader conceptualisation of how students engage with diverse course formats and how their perceptions and behaviours can evolve based on actual experiences.

Achieving comparable levels of performance and engagement in face-to-face and synchronous online learning modes is contingent upon the successful execution of techniques that effectively bridge the disparity between these two forms. In online learning modes, teachers are required to exert effort in establishing virtual classrooms that are interactive and captivating, mirroring the dynamics observed in conventional F2F educational settings. This may entail the use of real-time video conferencing to facilitate synchronous sessions, interactive tools, and multimedia components. Skilled facilitation is of extreme prominence, as teachers employ active learning strategies, asking open-ended questions, and moderating discussions to foster student engagement. In addition, the implementation of the establishment of a structured course schedule, much like F2F classes, helps students develop a sense of routine, thereby promoting active engagement. Promoting peer contact through collaborative projects and group discussions encourages social interaction and builds rapport in learning, similar to the experiences encountered in conventional face-to-face learning contexts. What's more, establishing an accessible and inclusive learning environment that caters to the needs of all students, including those with disabilities, fosters equity and cultivates a culture conducive to enhanced engagement and performance.

Successful outcomes in terms of student performance in both learning modes is contingent upon the congruence between assessment techniques and learning objectives. Instructors/teachers play a crucial role in sustaining student motivation and engagement by offering timely and constructive feedback on assignments and assessments (Valizadeh and Soltanpour, 2021). In addition, it is possible to establish a robust teacher presence in online learning environments through timely responses to student enquiries, proactive facilitation of discussions, and demonstrating enthusiasm for the subject matter. These practices play a critical role in fostering a sense of connection and engagement among

learners in the virtual setting. Through the proficient implementation of these strategies, educators have the potential to establish a synchronous online learning environment that closely replicates the levels of engagement and performance observed in traditional in-person instruction. This ensures that students are able to receive a meaningful and effective educational experience, irrespective of the mode of delivery.

7. Implications of the study

The findings of the present study have several implications for various stakeholders in university-level medical education, particularly those interested in the development and enhancement of synchronous online courses. First of all, these findings underscore the potential of well-structured online education to significantly contribute to improving education quality, thereby providing a valuable resource for curriculum designers and educational policymakers aiming to enhance medical education programs. Understanding that student engagement can be limited, teachers can employ different strategies to increase student engagement. What is more, by pointing to similar performance in online and F2F learning contexts, the study highlights the potential for synchronous online learning to bridge educational gaps in remote or underserved regions, thus promoting educational equity and access to quality instruction.

Additionally, by optimizing online learning environments, stakeholders can develop more cost effective online educational courses. Recognizing the challenge of possible lower engagement in online learning modes, teachers, educators, policy makers and other stakeholders can employ specific strategies (creating interactive course materials, fostering discussions through online forums, offering timely feedback, maintaining clear communication, ensuring instructor presence, encouraging peer collaboration, diversifying assessment methods, conducting regular check-ins, providing virtual office hours, incorporating gamification elements, using learning analytics, seeking continuous improvement based on student feedback, ensuring inclusivity, offering guidance on time management and self-discipline, and providing orientation and training) to create more engaging and effective learning experiences, thus avoiding the waste of valuable time and resources. The findings of this study have the potential to positively influence both the quality and accessibility of medical education, making it a more equitable and efficient endeavor for all stakeholders involved.

8. Limitations of the study

The present study exhibits several noteworthy limitations that deserve attention. A primary limitation pertains to the relatively small sample size in this study. Increasing the sample size could potentially yield insights into distinct patterns pertaining to student performance and engagement. An additional limitation emerges from the absence of gender considerations in the present study. It is conceivable that males and females might display different behaviors in online and face-to-face (F2F) learning contexts. Hence, future investigations can incorporate gender. Furthermore, the study does not delve into the influence of students' academic disciplines, which could potentially lead to differential behaviors in terms of engagement and performance, owing to the inherent variations in the nature and structure of different disciplines.

Research can consider academic the students' fields of study. Additionally, it is essential to acknowledge that the present study is primarily concerned with examining student engagement and performance within the context of online and F2F learning modes over a relatively short time frame. Future research can use a longitudinal approach, which can provide a comprehensive understanding of

how these factors evolve over time. In addition, future research can include other pertinent variables. These may encompass the students' expertise in online course participation, their familiarity with and perceptions of online courses, as well as the teachers' perceptions of online courses and their potential impact on student engagement and performance. Investigating these aspects could contribute valuable insights to the field. In conclusion, addressing these identified limitations through more extensive samples, gender inclusion, academic discipline consideration, and longitudinal approaches can greatly enhance the comprehensiveness and robustness of future research in this domain.

Author contributions

Conceptualization, SAH; methodology, SAH and SKN; software, SAH and AD; validation, SAH, AD and SKN; formal analysis, SAH, AD and SKN; investigation, SAH, AD and SKN; resources, SAH, AD and SKN; data curation, SA, AD and SKN; writing—original draft preparation, SA; writing—review and editing, SAH, AD, SKN and RM; visualization, SAH, AD, SKN and RM; supervision, SAH; project administration, SA, AD and SKN; funding acquisition, SA, AD, SKN and RM. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

The authors declare no conflict of interest.

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