

Synchronous vs Face-to-Face Instructions: A Comparative Study and Some Lessons Learned of Teaching Undergraduate Engineering Subject in the US vs Overseas

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Abstract

COVID 19 Pandemic and its long global persistence created challenges in the United States and many countries worldwide. As reported by the media, academic education had been one of the major sectors of the community that the arrival of this pandemic has significantly impacted and became temporarily paralyzed due to the high speed of infection of the virus. Due to their access to the high-speed internet system, many academic campuses and k-12 institutions have adopted online instructions and learning processes using the available group communication software systems, including Zoom, WebEx, SKYPE, etc., as a viable alternative method in the absence of face-to-face instructional opportunities. Although many experts in online teaching have discussed the positive and negative features of online education methods through their articles, a small number of articles concentrated on student learning abilities based on their cultural backgrounds and locations. This article reports the outcomes of a study primarily focused on student learning in two undergraduate engineering courses in an institution in the United States and its international branch. The study further reports on some success achieved due to modifications in the content and delivery methods that might be necessary to make a practical and positive impact on these learners.

Keywords

Effectiveness of online instructions; Face-to-face learning; Delivery Methods; Remote teaching and learning ability; Synchronous instructions.

1. Introduction

Over the past three decades, due to an increase in the standard of living of the general population in Qatar, the government's vision has been to transform the country's general economy from a fossil-based to a knowledge-based economy. And the government provides college education to a more significant number of their population who otherwise would not pursue education in foreign countries became more prominent. Many countries located in the Middle East and North Africa (MENA area) have consistently expressed interest in getting young high school graduates to earn college degrees from Western universities (Retnanto et al., 2022; Retnanto et al., 2021; Retnanto et al., 2020). Several North American and European higher education institutions were invited to establish campuses in these countries to achieve this goal. Several countries, including Qatar, United Arab Emirates (UAE), Kuwait, and several others, have taken the initiative and established campuses in their homelands.

Qatar and UAE have pioneered promoting higher education by establishing education and knowledge cities to attract a select number of well-regarded Western institutions to establish campuses and offer some of the main campus degrees over the past three decades. Among these countries, Qatar has established over ten campuses of Western academic institutions where local students have been pursuing degrees in engineering, medicine, business administration, computer science, international relations, nursing, allied healthcare, and communication (Retnanto et al. 2022; Retnanto et al. 2021; Qatar National 2015).

Located in the Persian Gulf, Qatar is a small peninsula that shares the land border with the Kingdom of Saudi Arabia and maritime borders with Bahrain and Iran. Qatar's Vision 2030 focuses on the capacity development of its natives. It has made significant investments in training and educating its native population and has been classified by the United Nations as a country of very high human development (Qatar National 2015; Toth 1993; Magee 2014; Commins 2021; Retnanto et al., 2012). Most of the young and upcoming Qatar high school graduates are fluent in English in addition to their native language of Arabic. With fewer travel restrictions to the country and the government's numerous initiatives, over 70 petrochemical companies have established joint ventures in the country. With its modern highway systems and state-of-the-art transportation and port facilities, Qatar is uniquely qualified to meet the country's Vision 2030. Qatar's investment in human capital has been one of the primary reasons for several top-tier American institutions, including Texas A&M University, to open a branch campus in its capital city, Doha. Texas A&M University at Qatar (TAMUQ) is located in Education City, presently referred to as Hamed Bin Khalifa University Education facilities, and started its operations in September 2003. TAMUQ has been offering four ABET-accredited engineering degrees in Chemical, Electrical, Mechanical, and Petroleum since 2003 and has awarded undergraduate degrees to over 1,300 candidates as of May 2022.

2. Background

COVID 19 and its widespread coverage brought severe challenges to the global communities. Lack of sufficient information concerning this pandemic and not knowing enough about the transmission pattern of this virus caused a great deal of confusion for organizations, particularly academic institutions. Many public educational institutions canceled face-to-face classes and relied on distance format. Although the highspeed 5G internet had been a new phenomenon in the United States in March 2020 and many regions did not have access to a reliable communication network, Qatar acquired and installed the equipment necessary to transmit 5G speed in 2018. And the systems have proven to be reliable and fully functional during their initial testing period. In March 2020, both Texas A&M University in College Station, Texas, and the TAMU Qatar campus switched to fully online instruction using multimedia tools. However, the primary focus of the study has been on the effectiveness of synchronous compared to the traditional face-to-face method of instruction that the majority of students have traditionally been used to them (Amani and Parsaei 2020).

3. Some Results and Observations of the Study

As reported earlier (Retnanto et al. 2022), the authors developed a short questionnaire. The questionnaire has been screened and approved by the Office of Human Research Protection Program at Texas A&M University, College Station campus asking students to convey their experiences in the classes taken prior (face-to-face) and during the policy adopted by the institution ((online) due to COVID. The questionnaire contained 20 questions divided into three categories: basic demographics, advantages and disadvantages of taking classes remotely, and a comparison between face-to-face and remotely accessing the subject materials (Retnanto et al. 2022.) The authors selected a sophomore-level course offered at the Texas A&M University campus in College Station (ISEN 210 – Introduction to Industrial and Systems Engineering Design) and a petroleum undergraduate class offered in Qatar.

The composition of ISEN 210-section 1 included 48 students, of which 17 were females, and 31 were males. The ISEN 210 (section 2) consisted of 13 females and 35 male students. The distribution of the gender in the petroleum undergraduate students was 21 females and 12 males. Enrollment in ISEN 210, section 1, included ten sophomores, 35 juniors, and three seniors, whereas, in ISEN 210, section 2, 22 sophomores, 25 juniors, and one senior student were enrolled. Petroleum undergraduate students included 13 sophomores, 7 juniors, and 13 senior students. As reported earlier, 67% of the students enrolled in ISEN 210 sections 1 and 2 identified their information technology (IT) skills at a moderate level; however, about 42 percent of the petroleum undergraduate students in the Qatar campus have chosen "high" for their IT skills (Figure 1). Around 50 percent of the students enrolled in ISEN 210 sections 1 and 2 have participated in any type of synchronous learning before the pandemic. In comparison, about 70 percent of the petroleum undergraduate students in the Qatar campus never participated in any type of remote learning (Figure 2). For further reading regarding this survey, readers are encouraged to see Retnanto et al. 2022.

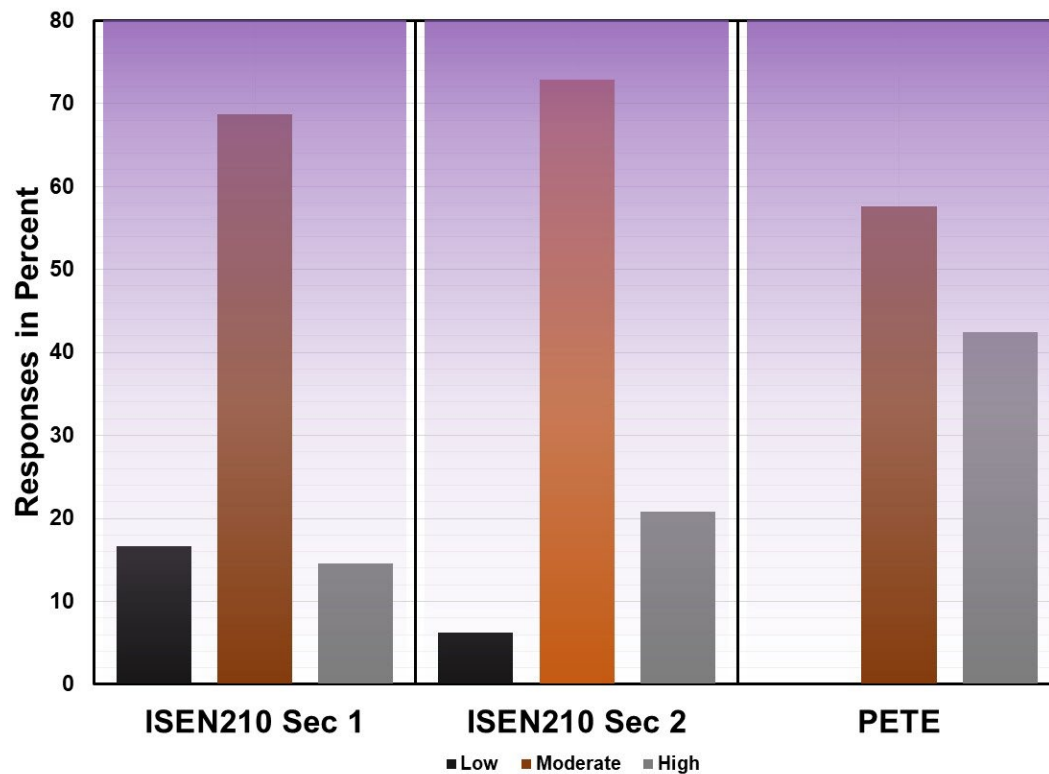


Figure 1. Students Level Information Technology (IT) Skills

Figures 3 and 4 depict the advantages and disadvantages of participating in class remotely (synchronous learning). Students were asked about the advantages of participating in class remotely (synchronous learning) such as access to online materials, learning at your own pace, staying at home, class interactivity, recording a meeting, and comfortable surroundings. The access to online materials and the ability to stay home are the most significant advantages for students enrolled in the ISEN 210 (sections 1 and 2). While the student on the Qatar campus also rated the access to online materials (76%) and the ability to stay home (85%) as substantial advantages. The “ability to record a meeting” was rated highly for ISEN 210 section 1 (77%), section 2 (65%), and the Qatar campus (73%). The class’s interactivity received the lowest advantage among all students.

Students were asked what disadvantages of participating in class remotely (synchronous learning) such as reduced interaction with the teacher, technical problems, lack of interactions with other students, poor learning conditions at home, lack of self-discipline, and social isolation. In figure 4, the “reduced interaction with the teacher” is the most major disadvantage of synchronous learning by students enrolled in the ISEN 210, sections 1 (83%) and 2 (83%), and the Qatar campus (64%). The “interaction with other students” is among the most significant disadvantages for students enrolled in the ISEN 210 section 1 (79%), section 2 (90%), and Qatar campus (58%).

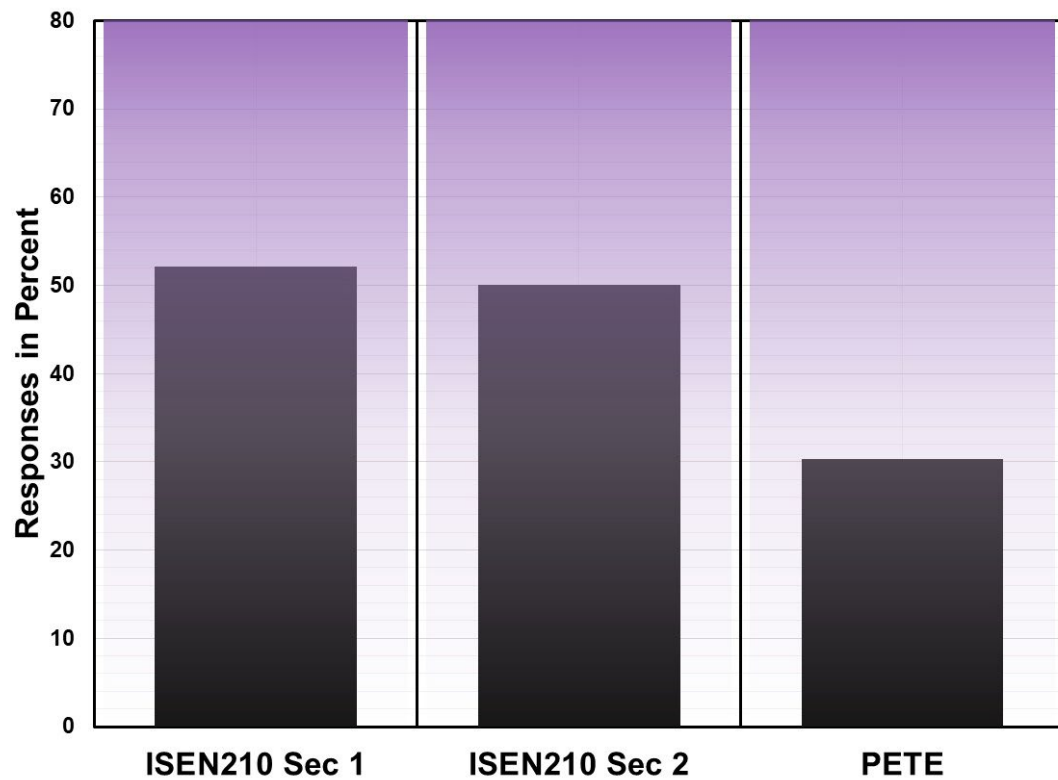


Figure 2. Participated in any Type of Synchronous Learning before the Pandemic

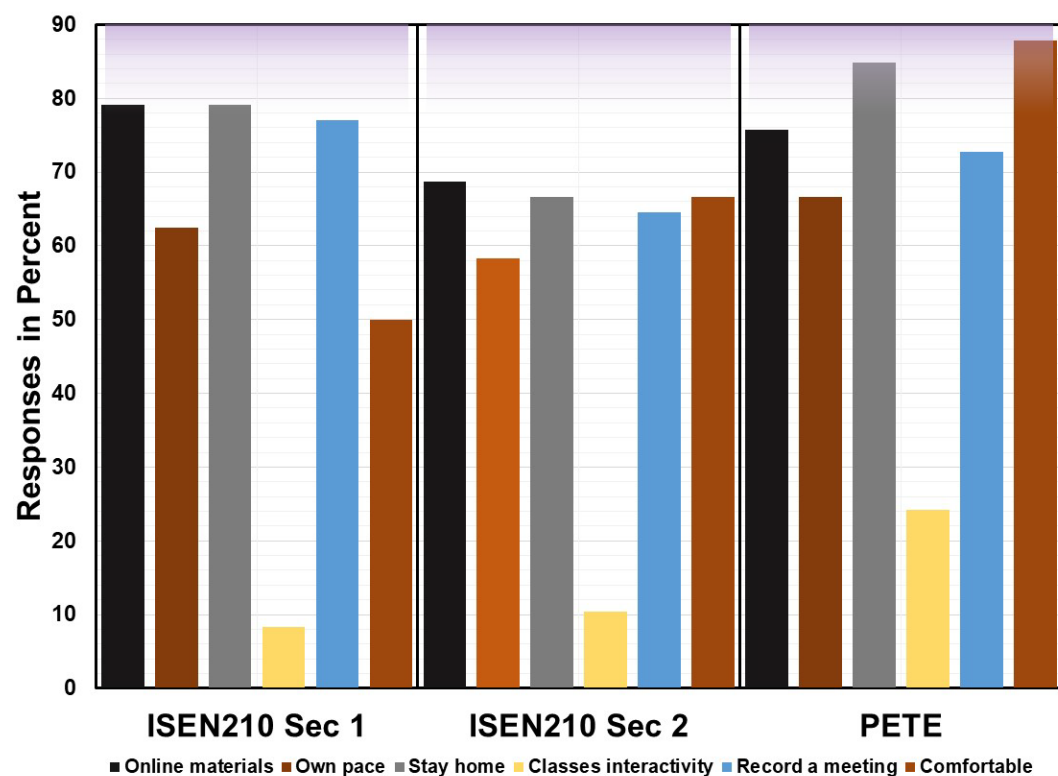


Figure 3. Advantages of Participating in Class Remotely (synchronous learning)

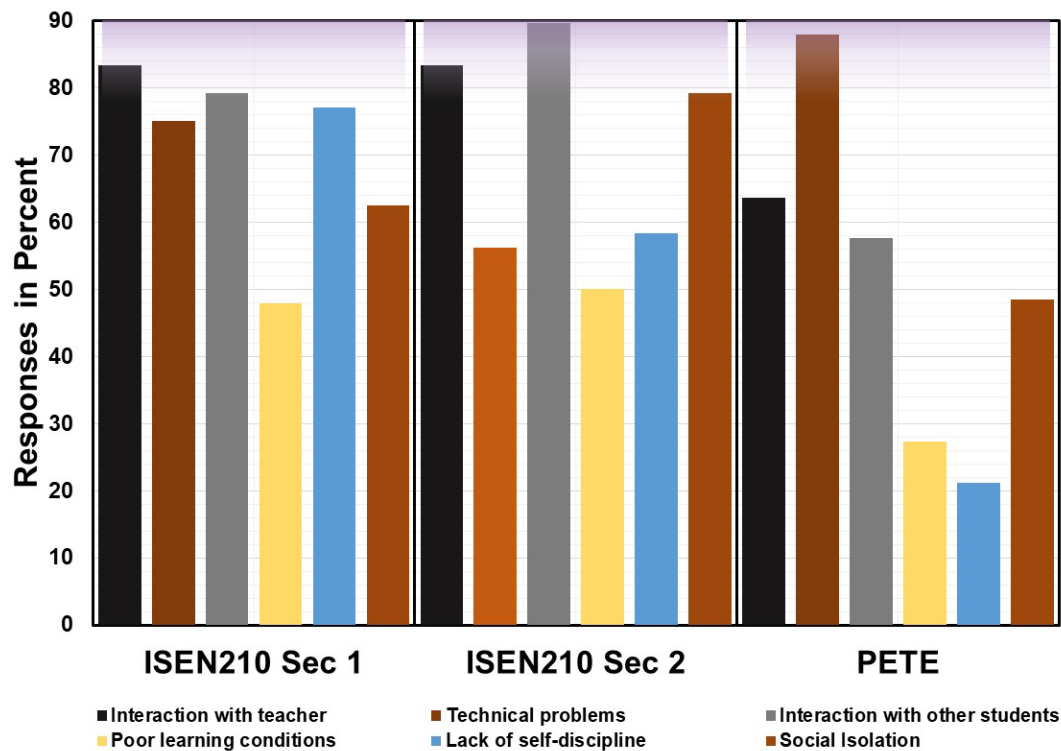


Figure 4. Disadvantages of Participating in Class Remotely (synchronous learning)

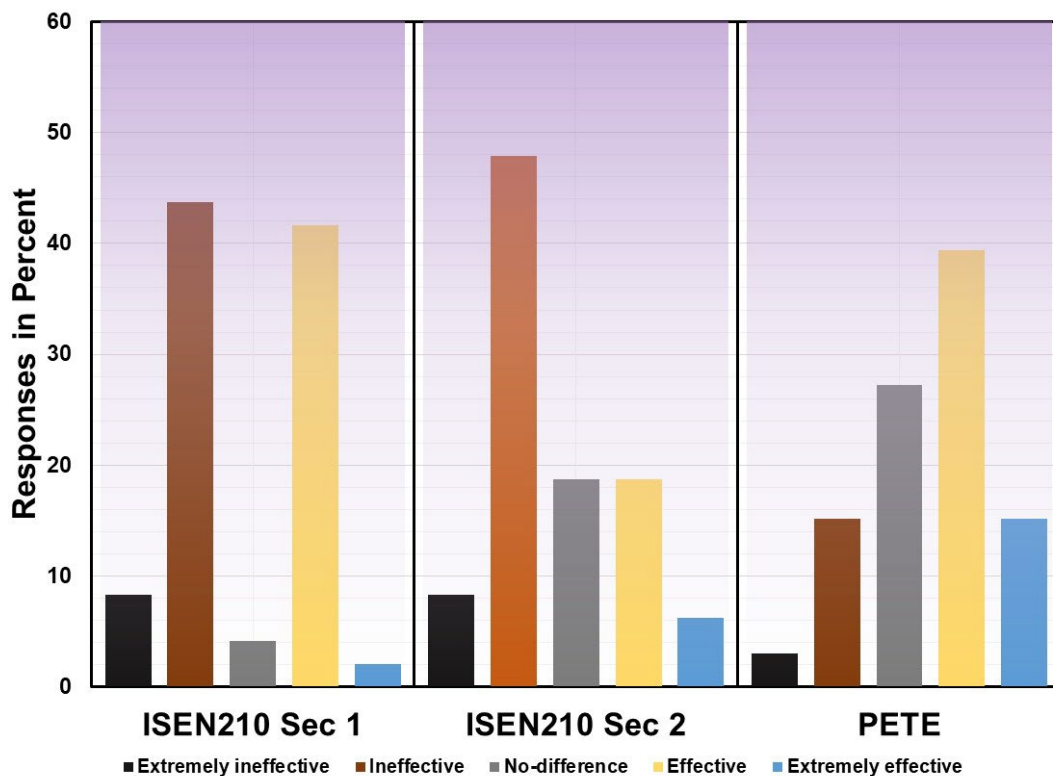


Figure 5. Participating in Class Remotely in Terms of Increasing Knowledge Theoretically

Figure 5 illustrates the survey results when students were asked to rate the effectiveness of participating in class remotely (synchronous learning) in terms of increasing knowledge theoretically. In the ISEN 210 sections 1 and 2, over 52% and 56%, respectively, felt that participating in class remotely in terms of increasing knowledge theoretically was ineffective or extremely ineffective. However, only 18% of petroleum engineering students in

the Qatar campus concluded participating in class remotely was ineffective or extremely ineffective. The main reason could be due to the class size in synchronous learning.

Figure 6 shows the result of the survey when students were asked to rate the effectiveness of traditional face-to-face learning in terms of increasing knowledge theoretically. In the ISEN 210 sections 1 and 2, over 77% and 75%, respectively, felt that participating in traditional face-to-face learning in terms of increasing knowledge theoretically was effective or extremely effective. More than 64% of petroleum engineering students on the Qatar campus came to the same conclusions. Compared to participating in class remotely (synchronous learning), students enrolled in ISEN 210 sections 1 and 2, and Qatar Campus prefer traditional face-to-face learning to increase knowledge theoretically.

Figure 7 depicts the survey result when students were asked to rate the effectiveness of participating in class remotely in terms of increasing practical/calculation skills. In the ISEN 210 sections 1 and 2, over 54% and 44%, respectively, felt that participating in class remotely in terms of increasing practical/calculation skills was ineffective or extremely ineffective. Similarly, 39% of petroleum engineering students in the Qatar campus concluded participating in class remotely was ineffective or extremely ineffective.

Figure 8 presents the survey result when students were asked to rate the effectiveness of traditional face-to-face learning in terms of increasing practical/calculation skills. In the ISEN 210 sections 1 and 2, over 81% and 71%, respectively, felt that participating in traditional face-to-face learning in terms of increasing practical/calculation skills was effective or extremely effective. More than 70% of petroleum engineering students on the Qatar campus came to the same conclusions. Compared to participating in class remotely (synchronous learning), students enrolled in ISEN 210 sections 1 and 2, and Qatar Campus prefer traditional face-to-face learning to increase practical/calculation skills.

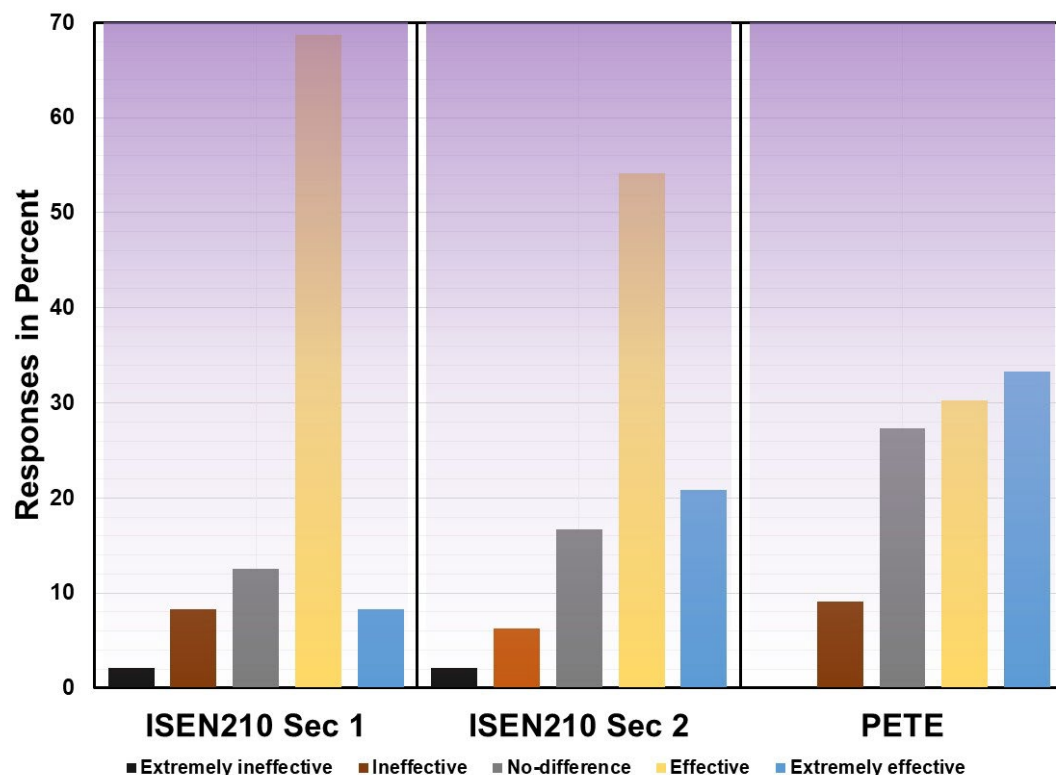


Figure 6. Participating in Traditional Face-to-face Learning in Terms of Increasing Knowledge Theoretically

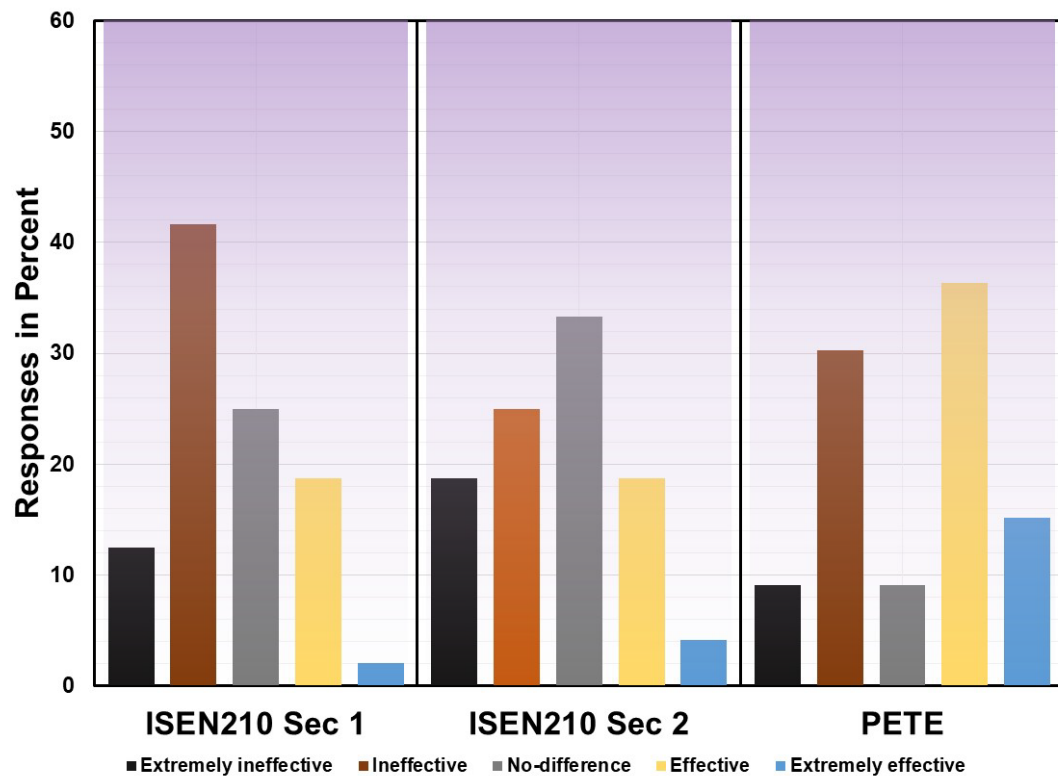


Figure 7. Participating in Class Remotely in Terms of Increasing Practical/Calculation Skills

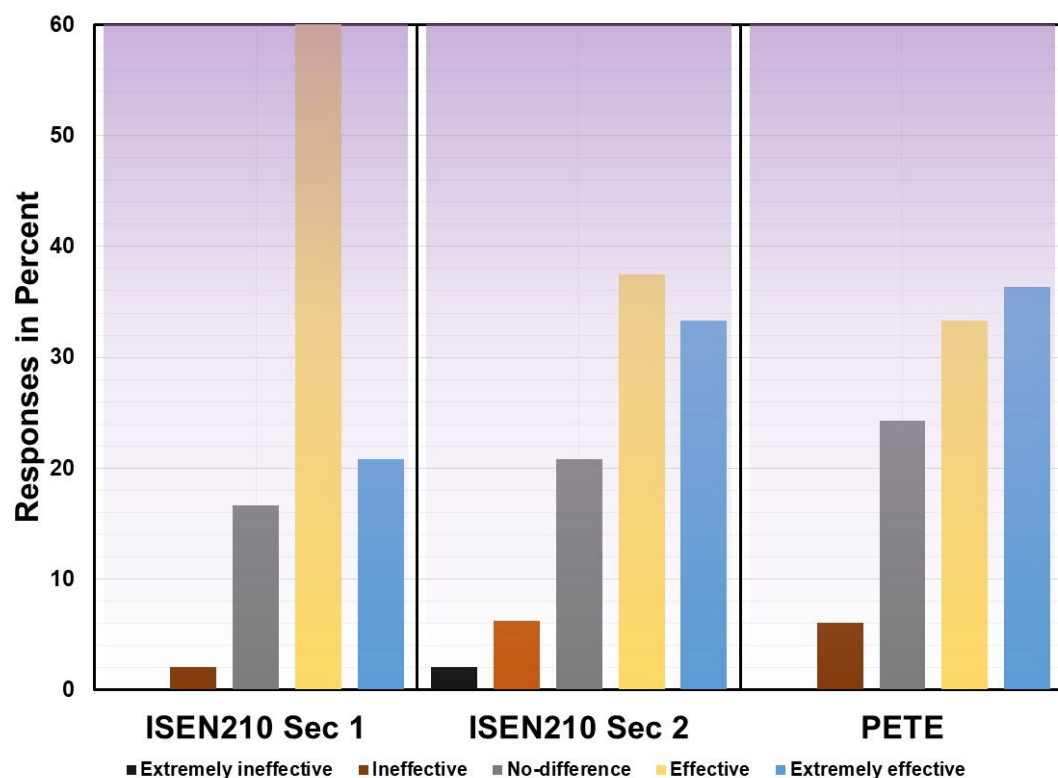


Figure 8. Participating in Traditional Face-to-face Learning in Terms of Increasing Practical/Calculation Skills

During the pandemic, students could not perform hands-on experimental work in the laboratory. Figure 9 presents the rate of the effectiveness of participating in class remotely in terms of increasing engineering laboratories' skills. In the ISEN 210 sections 1 and 2, over 94% and 85%, respectively, felt that participating in class remotely in terms of increasing engineering laboratories skills was ineffective or extremely ineffective. On the Qatar

campus, more than 67% concluded participating in class remotely was ineffective or extremely ineffective for the laboratory skills.

Figure 10 shows the rate of the effectiveness of traditional face-to-face learning in terms of increasing engineering laboratories' skills. In the ISEN 210 sections 1 and 2, over 92% and 88%, respectively, felt that participating in traditional face-to-face learning in terms of increasing engineering laboratories skills was effective or extremely effective. On the Qatar campus, more than 82% also felt that participating in traditional face-to-face learning to increase engineering laboratory skills was effective or extremely effective.

In addition to laboratory skills, students could not participate in the field trips. Figure 11 depicts the field trip for petroleum engineering students in order to know field operations and connect with their course material.

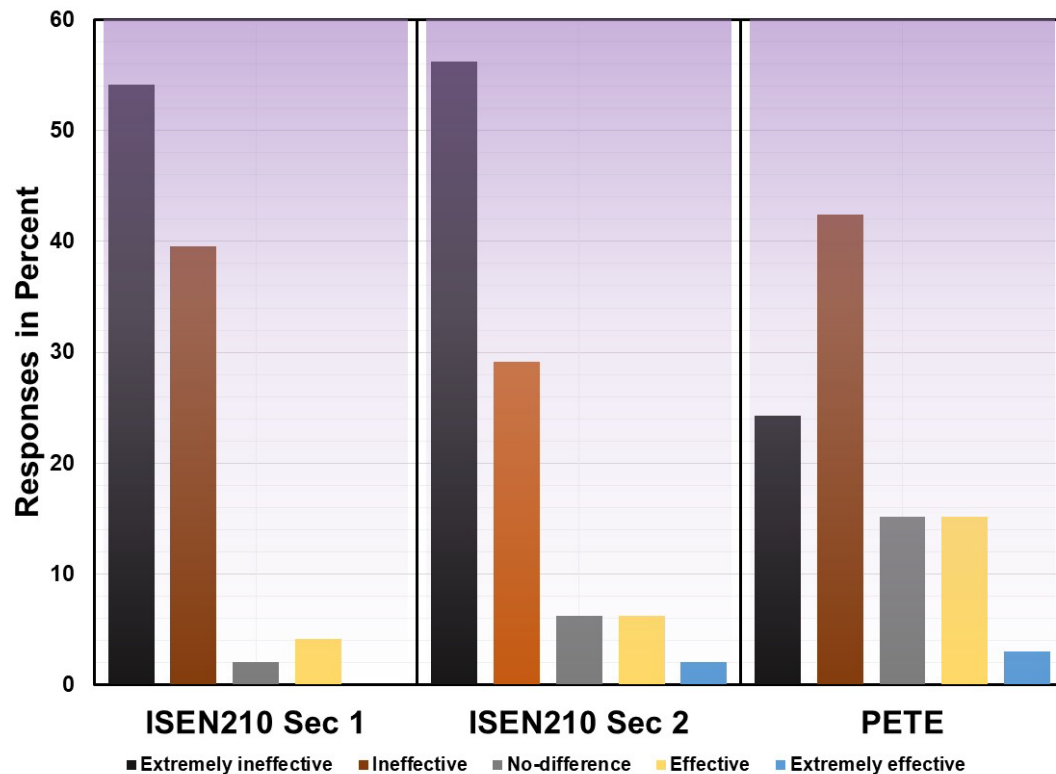


Figure 9. Participating in Class Remotely in Terms of Increasing Engineering Laboratories Skills

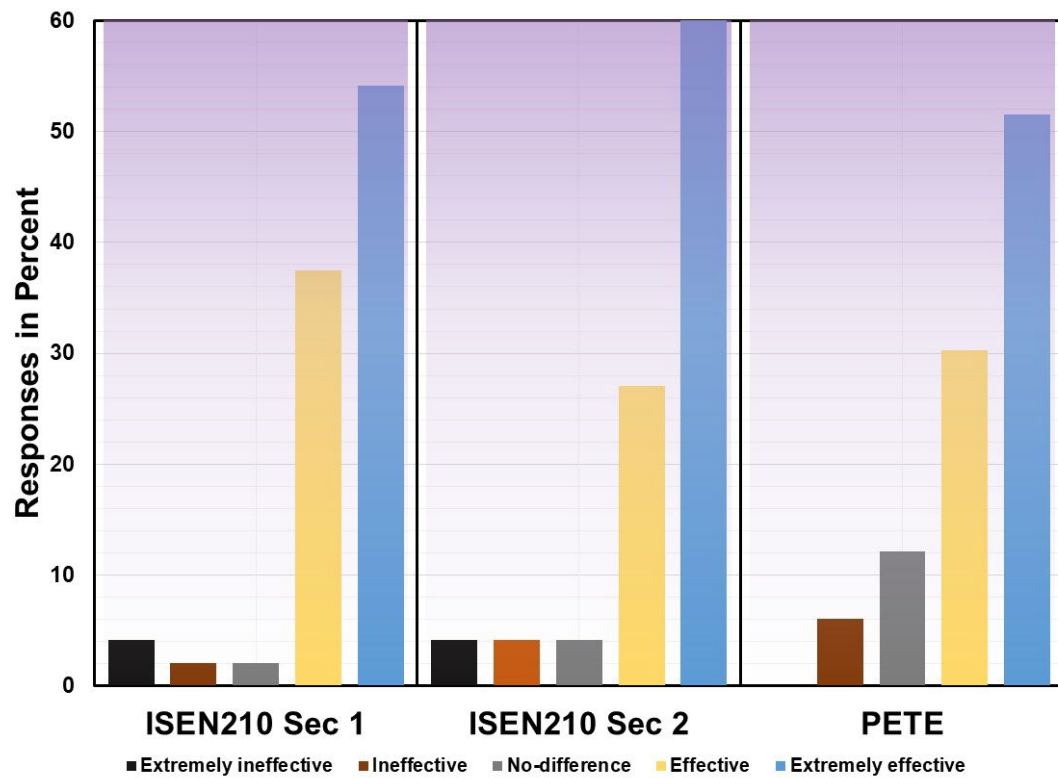


Figure 10. Participating in Traditional Face-to-face Learning in Terms of Increasing Engineering Laboratories Skills



Figure 11 . Petroleum Engineering Student at TAMUQ Field Trip to the Drilling Rig (Retnanto et al. 2019)

4. Conclusion

The results indicated that information technology (IT) knowledge played an important role in facilitating the remote or synchronous learning method and provided the Qatar campus students assigned a higher score for this element. The results also indicated that students were less respective to remote learning (synchronous) for the classes with laboratory components. The influence of a reliable high-speed internet system contributed to students' ability to retrieve and connect with their instructors and classmates was pertinent. However, the questionnaire did not pose any questions regarding this issue as the uploading, and the downloading speed of the network was not under the control of either the academic institution or course instructors. It is also pertinent that the face-to-face instructions and having access to course instructors for theoretical courses were preferred as they could speed up the learning process.

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Biography

Dr. Albertus Retnanto is a Professor of Petroleum Engineering at Texas A&M University at Qatar and has been in the Petroleum Engineering program since 2009. He received his Ph.D. degree in Petroleum Engineering from Texas A&M University. He teaches undergraduate courses in well testing, petroleum production systems, production engineering, petroleum technical presentation, natural gas engineering, and integrated asset development and makes significant curriculum enhancements to several courses. He held a Principal position with Schlumberger and has more than 18 years of experience worldwide in technical and management positions in well testing, field development, and production enhancement. Dr. Retnanto is an active Program Evaluator (PEV) with the Engineering Accreditation Commission (EAC) of ABET.

Dr. Hamid R. Parsaei is an internationally recognized leader in the field of engineering education, manufacturing automation, economic and financial decision making, leadership, and additive manufacturing with more than three decades of experience in academia. He is a fellow of the Institute of Industrial and Systems Engineers (IISE), American Society for Engineering Education (ASEE), Society of Manufacturing Engineers (SME), and Industrial Engineering and Operations Management Society International (IEOM). Dr. Parsaei is an effective educator and

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