

# **Teaching and Learning Using In-Class Remotely vs. Traditional Face-to-Face Methods: An Empirical Study**

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## **Abstract**

The recent global pandemic and the academic efforts, nationally and internationally, to minimize teaching and learning interruption due to this unexpected phenomenon provided educators an opportunity to explore alternative teaching and learning methods. Several online communication mediums saw opportunities to explore these needs and stimulate the innovative use of these technologies. The engineering education community was among the groups who cautiously led this transformation. Over the past twenty years, the Texas A&M University-Qatar campus has established itself as one of the leading academic institutions in the region. The Education City in Doha, Qatar, houses six American university branches, among which Texas A&M University-Qatar is the only one that offers four ABET-accredited engineering degrees in Chemical, Electrical, Mechanical, and Petroleum. Texas A&M University-Qatar campus has consistently been regarded as an institution that often takes the lead in developing, implementing, and assessing the most innovative use of innovative teaching and learning methods to engage students in learning further actively.

This paper reports some of the results of an empirical study conducted at Texas A&M University in Qatar and Texas A&M University in College Station, Texas, in two undergraduate courses taught on these two campuses. This study also compared students' academic performance in synchronous learning environments with face-to-face teaching and learning options.

## **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, most countries around the Persian Gulf (Gulf Countries) developed plans to improve living standards and transition their fossil fuel-based economy to a knowledge-based economy. One of the main pillars of these countries' vision is education, in particular Western education. In several cases, the governing bodies selectively invited some of the globally recognized universities to open a formal branch in the country and attract the young generation to pursue Western education (Retnanto et al. 2022; Retnanto et al. 2012; Retnanto et al. 2020). Western education, particularly engineering, medicine, law, journalism, political science, business and finance, and interior design, has proven attractive to young high school graduates. In the late 1990's several Gulf countries, including Qatar, United Arab Emirates, and Kuwait, became pioneers by establishing Western campuses in their countries.

Qatar is one of the leaders in adopting Western education and encouraging its young generation to pursue it. Qatar is a small peninsula in the Persian Gulf that shares the land border with the Kingdom of Saudi Arabia and maritime borders with Bahrain and Iran. Qatar's Vision 2030, proposed by its royal family and adopted in the late 1990's concentrates on the capacity development of its citizens. Qatar is among a few countries in the world which made a significant investment in implementing some of the highest standards of living and promoting higher education among its young generation (Qatar National 2015; Toth 1993; Magee 2014; Commins 2021; Retnanto et al. 2022). Since 2010 Qatar has invested significantly in developing and implementing state-of-the-art infrastructure, including roads, high-speed communication systems, airports, banking, and commerce.

Furthermore, Qatar has chosen to teach English as a second language in addition to its native language, Arabic. Today, almost all high school graduates are fluent in communicating in English. Over the past twenty-five years, several American universities, including Texas A&M University, Cornell University, Northwestern University, Carnegie Mellon University, and Georgetown University, opened campuses and have been offering degrees in engineering, medicine, computer science, business administration, journalism, political science, and interior design, and many more. These universities are all located in Education City (recently renamed as Hamed Bin Khalifa University campus), a very modern location in the Qatar capital city of Doha. Over 1,300 completed and received degrees in Chemical Engineering, Electrical Engineering, Mechanical Engineering, and Petroleum Engineering from Texas A&M University Qatar campus (TAMUQ) since its inception in 2002.

## **2. Background**

The arrival of the COVID virus and the political decisions to limit its widespread by shutting down all public gathering places, including schools, public transportation, places of worship, etc., and the lack of general knowledge in handling and managing the pandemic and its monumental transmission rate halted the global community's operations. Most educational institutions extended their Spring breaks and decided to resume the Spring 2020 academic semester by utilizing available mass communication systems such as Zoom, SKYPE, and other tools. Several of these tools were not fully tested, and their limitations were not fully tested in the past; however, most academic institutions decided to use these systems as an alternative to face-to-face instructional methods. Qatar, unlike many Western countries, has been utilizing 5G speed communication systems since 2018. All Texas A&M University campuses, including College Station and Qatar, trained its faculty, staff, and students using these multimedia systems. Texas A&M University in College Station, Texas, and the TAMU Qatar campus switched to fully online instruction using multimedia tools.

## **3. Methods**

The study intends to compare teaching and learning using in-class remotely vs. traditional face-to-face methods. For this purpose, the authors provided a short questionnaire (screened and approved by the Human Research Protection Program at Texas A&M University, College Station campus) requesting students' experiences of taking courses face-to-face and in-class remotely. The questionnaire consisted of 20 questions, including basic demographics, advantages and disadvantages of face-to-face class and in-class remotely, and accessing the subject materials remotely (Retnanto et al., 2022). One undergraduate course, ISEN 210 – Introduction to Industrial and Systems Engineering Design, was offered at the Texas A&M University campus in College Station, and petroleum undergraduate students were selected for the study. The two sections of the fall 2021 academic semester ISEN 210 involved in this study and petroleum undergraduate students during the same academic semester. (Retnanto et al. 2022).

#### **4. Data Collection**

Table 1 provided students enrollment participated in the survey. A total of 129 students responded to the empirical study in this paper.

**Table 1 – Student Enrollments**

Course	Females	Males	Total Students
ISEN 210 – Section 1	17	31	48
ISEN 210 – Section 2	13	35	48
Petroleum Engineering Students	21	12	33

Table 2 shows the student classification spread from sophomore to senior level. ISEN 210 is offered in multiple sections in the academic semester.

**Table 2 – Student Classification**

Course	Sophomore	Junior	Senior	Total
ISEN 210 – Section 1	10	35	3	48
ISEN 210 – Section 2	22	25	1	48
Petroleum Engineering Students	13	7	13	33

Figure 1 shows the level of student skill in information technology. Most students in ISEN 210 sections 1 and 2 classified their information technology (IT) skills as "moderate." And over eighty percent of both sections have a moderate or high level. Around 42 percent of the Qatar campus Petroleum Engineering students have chosen "high" for their IT skills. At the same time, all Petroleum Engineering students identified their IT skills as moderate or high. With a more reliable high-speed internet system, most Z generation is familiar with the virtual online method available as part of group communication.

Figure 2 shows the advantages of undergraduate students in taking classes and participating in class remotely (synchronous learning). The access to online materials (80% in the ISEN 210, section 1, and 70% in the ISEN 210 section 2) demonstrated the highest advantages for the online classes. At the same time, 76% of petroleum engineering students in Qatar Campus highlighted the same advantages of accessing online materials.

Another significant advantage of participating in the class remotely chosen by students enrolled in the ISEN 210, sections 1 and 2, was "the ability to record a meeting" (77% and 65%, respectively). Similar responses were provided by students enrolled in the petroleum undergraduate students on the Qatar campus. The Qatar campus students rated "the ability to record a meeting " at 65%.

However, class interactivity received the lowest percentage for the advantage of participating in class remotely for all students. For ISEN 210 students, there are only 8% in section 1 and 10% in section 2, while for petroleum engineering students is only 24%.

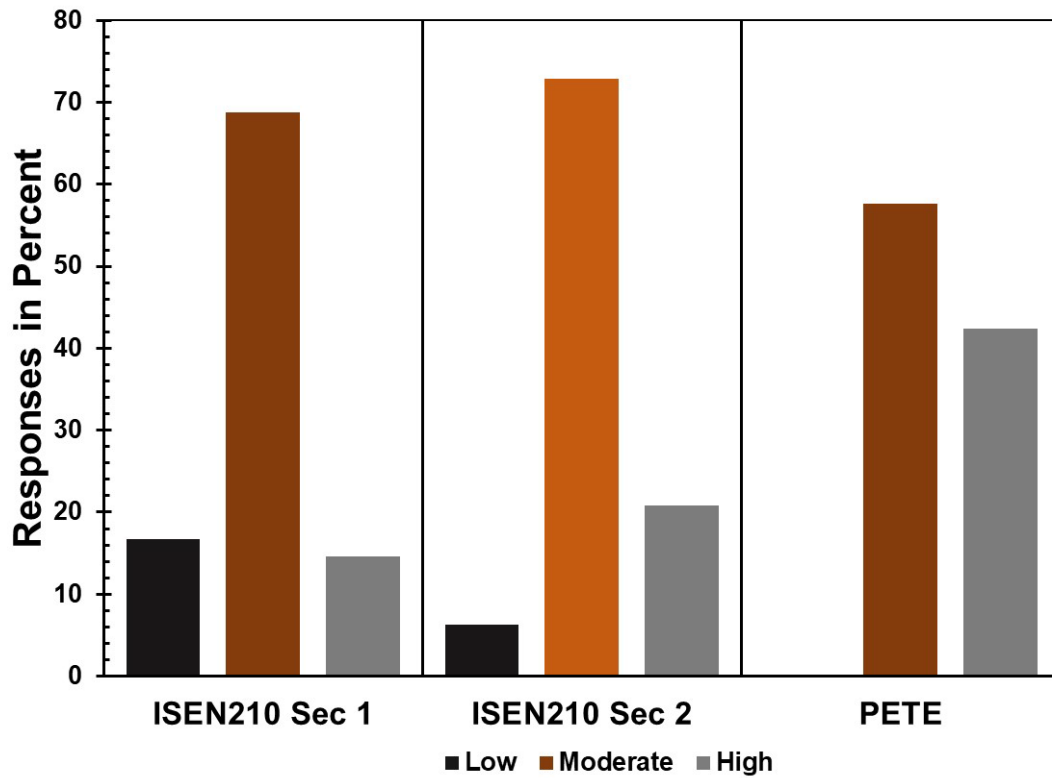


Figure 1. Students Level Information Technology (IT) Skills

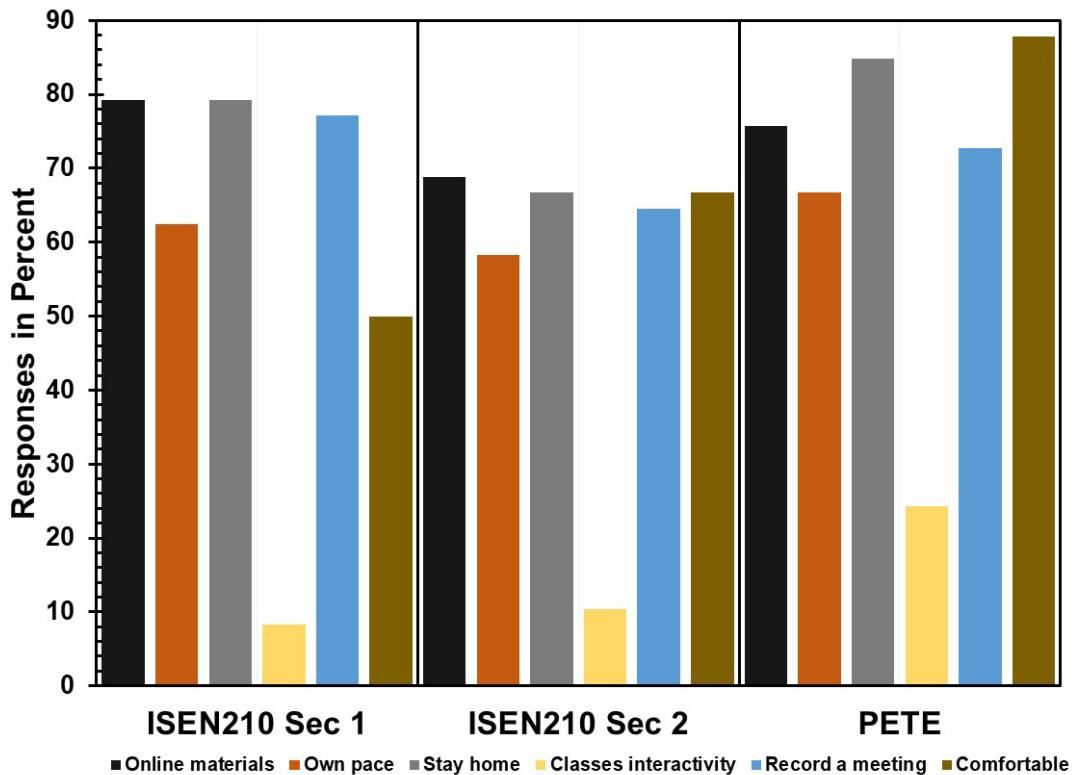
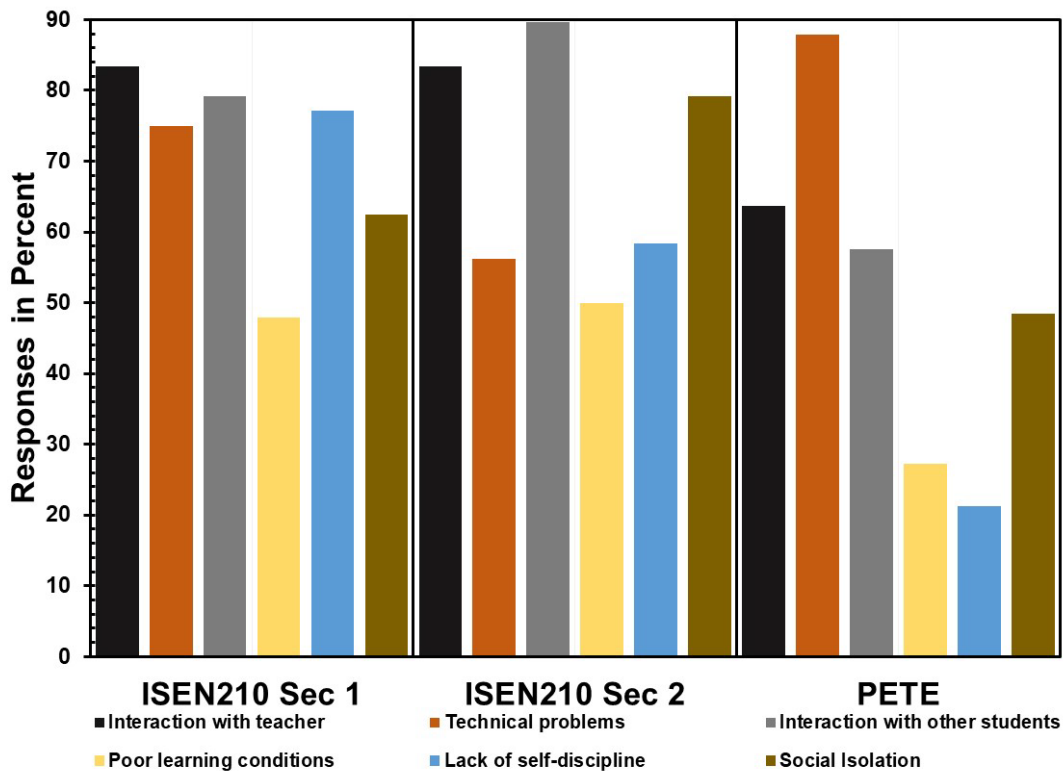


Figure 2. Advantages of Participating in Class Remotely (synchronous learning)

The disadvantage of participating in class remotely (synchronous learning) is presented in Figure 3. Interaction with the teacher and other students contributed to the most significant disadvantage. Around 83% of students in ISEN 210 sections 1 and 2 and 64% of the student of petroleum undergraduate selected the "reduced interaction with the teacher" as the significant disadvantage. Around 88% of petroleum engineering students thought the "technical problems" were the primary disadvantages of synchronous learning.

Social isolation also contributed to the disadvantage of the synchronous learning method. 62% of students in ISEN 210 section 1 and 79% in section 2 indicated social isolation as the disadvantage of remote learning. In comparison, 48% of petroleum students shared the same conditions.



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

## 5. Results and Discussion

The biggest challenge during the pandemic, engineering students could not perform hands-on experimental work in their technical laboratories. Any other means to deliver the laboratory courses could not resemble the same experience as in the laboratory. The rate of the effectiveness of participating in class remotely in terms of increasing engineering laboratories' skills is presented in Figure 9. The majority of engineering students on both campuses experienced ineffective experience for their laboratory 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 in-class remotely was ineffective or extremely ineffective for laboratory skills.

On the opposite, the rate of the effectiveness of traditional face-to-face learning in terms of increasing engineering laboratories' skills is presented in Figure 10. On both campuses, engineering students felt the laboratory courses should be performed as traditional face-to-face learning. 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.

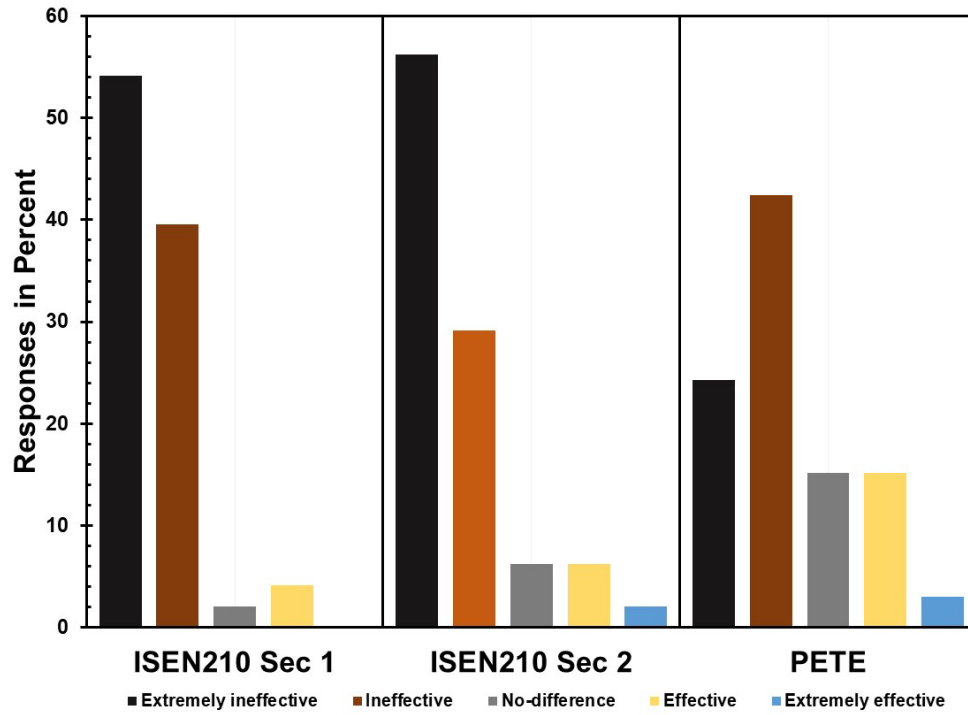


Figure 4. Participating in Class Remotely in Terms of Increasing Engineering Laboratories Skills

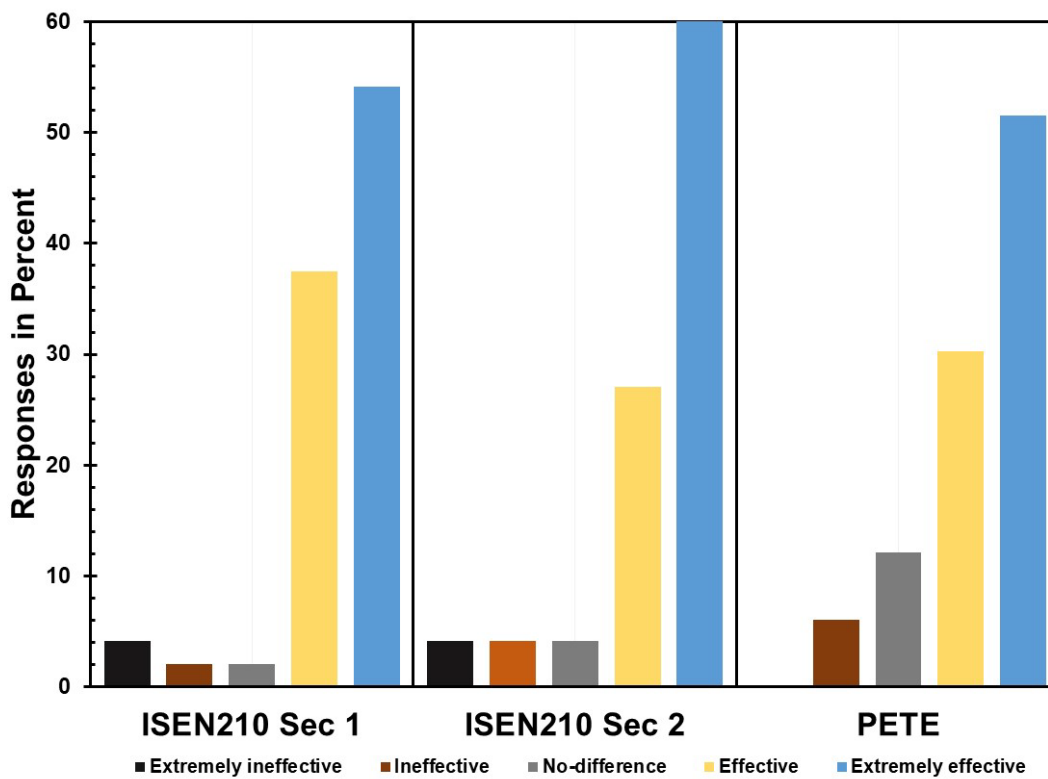
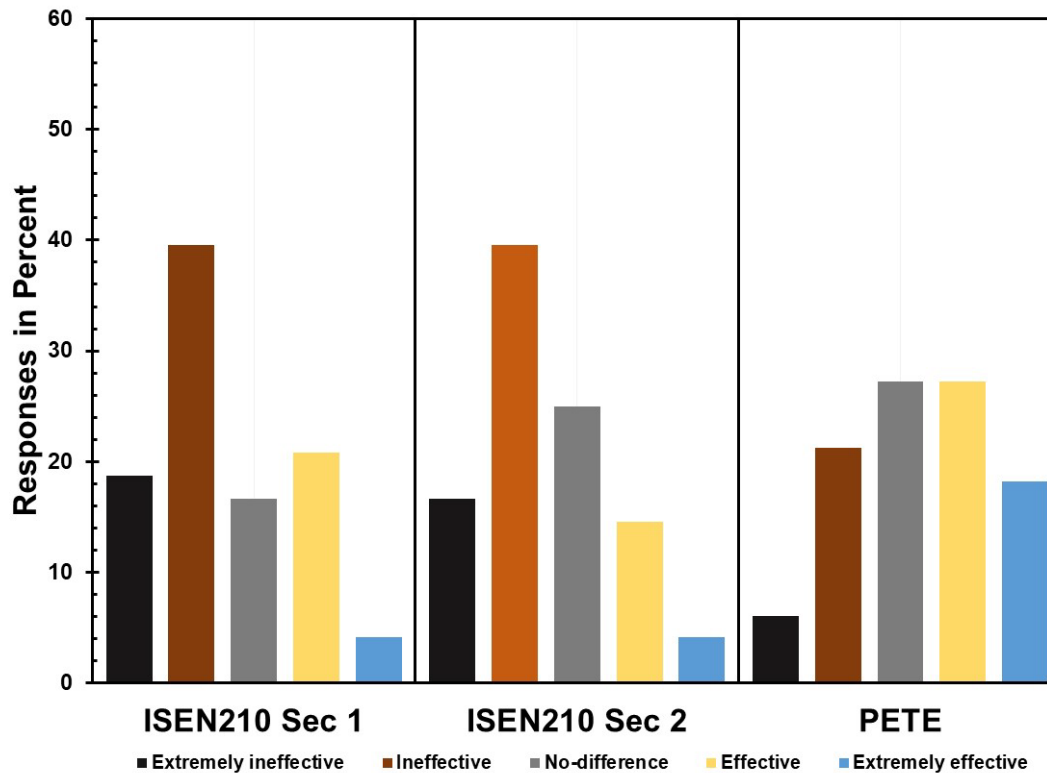


Figure 5 . Participating in Traditional Face-to-face Learning in Terms of Increasing Engineering Laboratories Skills



**Figure 6. Class participation during in-class remotely (synchronous learning)**

In addition to laboratory skills, engineering students could not participate in research. Performing hands-on experimental work and doing research enhance student knowledge (Amani et al. 2015).

Class participation is very important for students in their learning process. Figures 6 and 7 show the class participation during in-class remotely (synchronous learning) and traditional face-to-face learning. As a result of the survey, one of the important observations was that in the bigger class, students felt extremely ineffective or ineffective class participation remotely. Figure 6 shows that in ISEN 210 sections 1 and 2, more than 55% (58% in section 1 and 56% in section 2) felt extremely ineffective or ineffective class participation. While for the Qatar campus, with smaller classes, around 45% of them believed class participation in-class remotely is effective or extremely effective. The faculty provided several ways to deliver the course and support outside the class time. Conversely, less than 25% of ISEN 210 section 1 and 2 students came to that conclusion.

Figure 8 and 9 shows the academic performance during in-class remote and traditional face-to-face learning. In ISEN 210 sections 1 and 2, over 50% felt that their academic performance was ineffective or extremely ineffective. On the contrary, in ISEN 210 sections 1 and 2, over 81% and 66%, respectively, considered their academic performance effective or extremely effective. In the Qatar campus, only around 12% believed that their academic performance was extremely ineffective or ineffective. Furthermore, more than 60% concluded the academic performance to be effective or extremely effective in both cases.

It seems that class participation has a strong relationship with undergraduate students' academic performance. Class participation demonstrates as a critical point to enhancing their learning process.

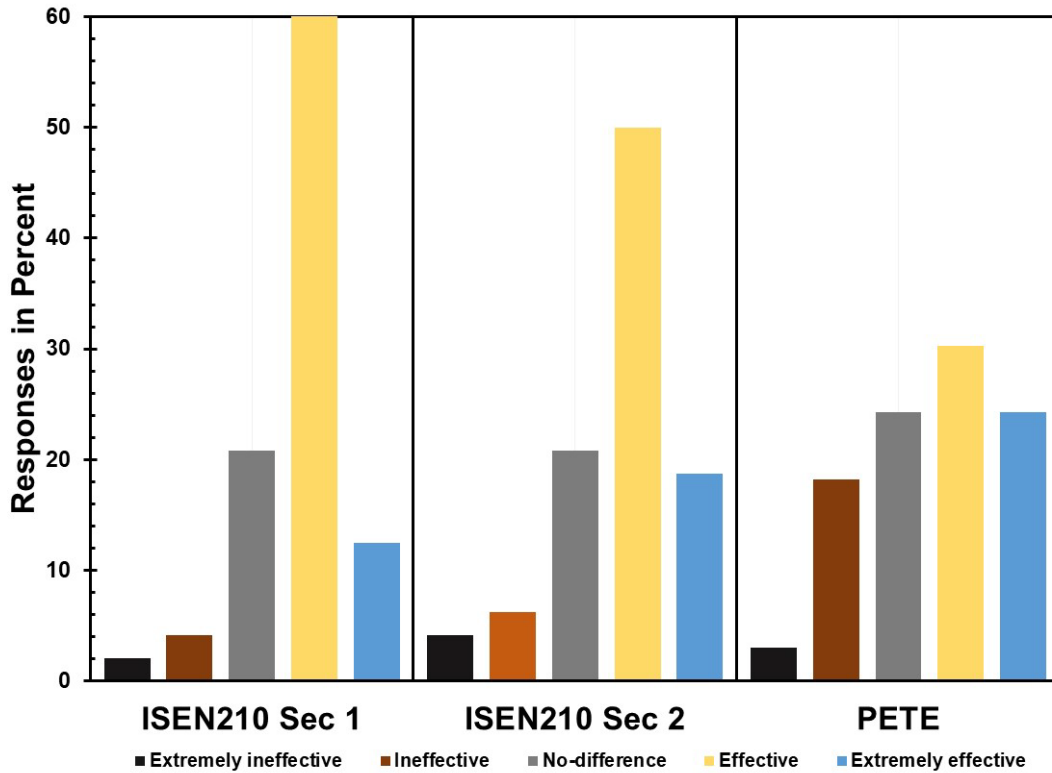


Figure 7. Class participation during traditional face-to-face learning

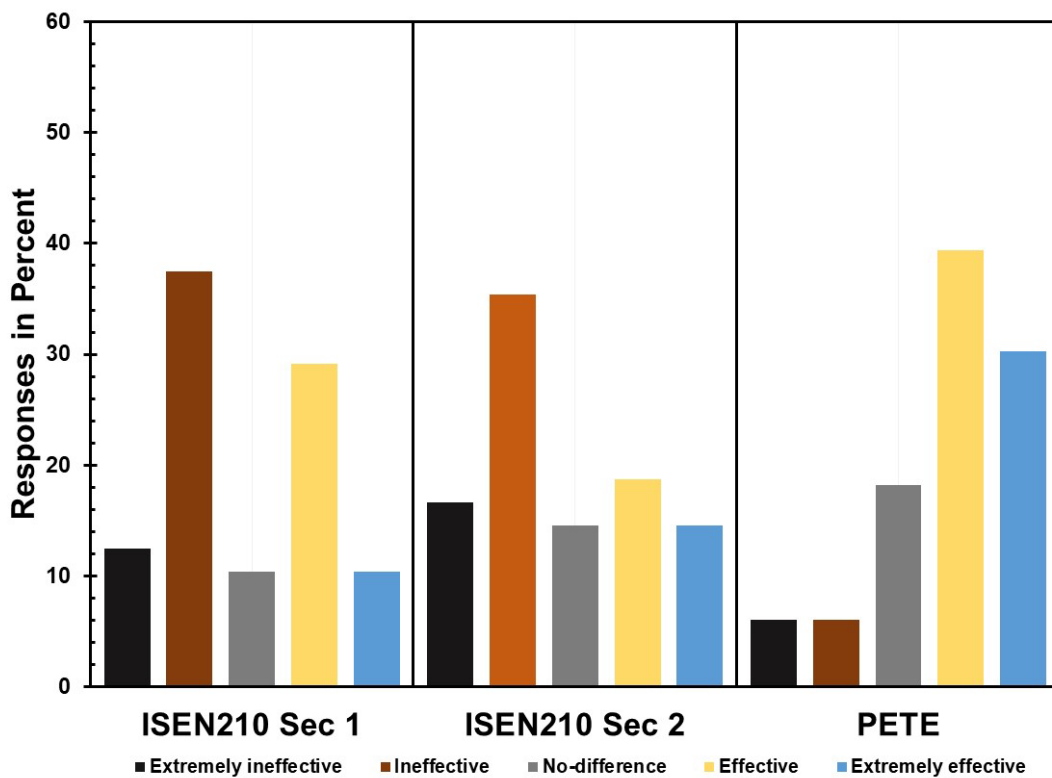


Figure 8. Academic performance during in-class remotely (synchronous learning)



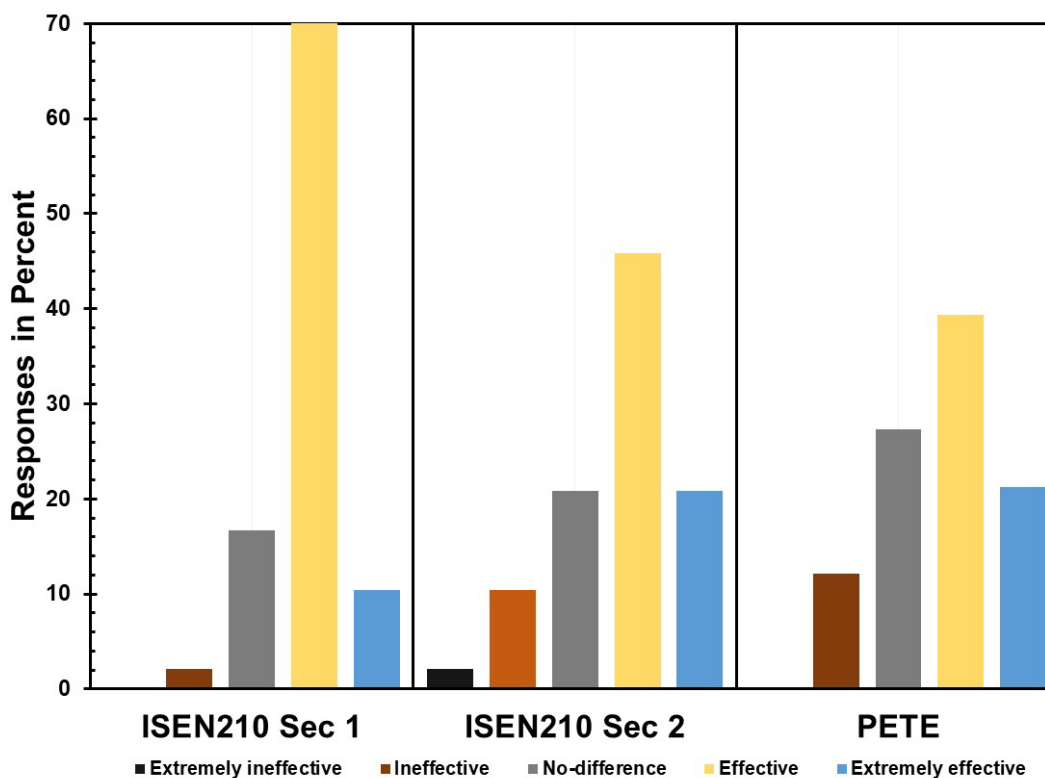


Figure 9. Academic performance during traditional face-to-face learning

## 6. Conclusion

The responses provided by undergraduate students from both campuses showed several similarities. The knowledge of information technology (IT) plays a key role in synchronous learning. The availability of high-speed internet affected how students participated in the classes and collaborated with their peers. The survey identified that class participation affected the academic performance of the student. It is also pertinent that access to course instructors and face-to-face instructions were preferred as both of them could speed up the learning process. The availability of the course materials should be continued during face-to-face learning and not limited only to online courses.

The survey results also showed that students for the classes with laboratory components were less respective to remote learning (synchronous). The main disadvantage for engineering students in remote learning is the ability to perform hands-on experimental work and do research. The academic performance appeared better during traditional face-to-face.

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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 an innovative researcher who draws on considerable expertise to lead colleagues toward visionary goals and exceptional results. He served as the Chair of the Department of Industrial Engineering at the University of Houston and Associate Dean of Academic Affairs at Texas A&M University at Qatar. He is a registered professional engineer in the State of Texas and an ABET Engineering Accreditation Commissioner and Program Evaluator. Dr. Parsaei is currently a Professor with the Wm Michael Barnes '64 Department of Industrial and Systems Engineering and Director of the College of Engineering Accreditation and Assessment.

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