Journal of Educational Technology & Online Learning
Volume 7 | Issue 3 | 2024

JETOL
Journal of Educational Technology & Online Learning

Engagement dynamics in information technology education: A comparative analysis of online vs. face-to-face instruction

Semiral Öncü [a], Merve Çolakoğlu [b *], Huseyin Colak [c]

[a] Balikesir University, Türkiye, semiral@gmail.com
[b] Unaffiliated, Türkiye, merwecolakoglu@icloud.com
[c] Northeastern Illinois University, USA, h-colak@neiu.edu

Suggested citation: Öncü, S., Çolakoğlu, M. & Colak, H. (2024). Engagement dynamics in information technology education: A comparative analysis of online vs. face-to-face instruction. *Journal of Educational Technology & Online Learning*, 7(3), 321-333.

Highlights

- Investigate differences in student engagement and achievement between online and face-to-face courses.
- Examine gender differences in engagement and achievement.
- Female students in face-to-face instruction showed decreased engagement towards final exams.
- Significant drop in scores for active learning and paying attention among these female students.
- Similar performance scores achieved in online mode with less effort compared to face-to-face mode.

Article Info: Research Article

Keywords: *Student engagement, achievement, delivery format, gender, online, face-to-face.*

Abstract

The purpose of this study was to investigate whether taking a course online or face-to-face matters in terms of student engagement and achievement. Gender differences were also examined. The level of student engagement in an information technology course in a freshman sample from a school of education was surveyed and compared in two consecutive years where the course was taught online in the first year and face-to-face in the second year. There were a total of 129 students, 62 in the online mode and 67 in the face-to-face mode. Data were collected using a survey that included a student engagement scale, as well as midterm and final exams. Non-parametric analyses were used due to data with non-normal distributions for some of the dependent variables, with the Mann–Whitney U test being the main form of analysis for group comparisons. Regarding gender, female students who received face-to-face instruction lost interest in the course toward the final exams, as evidenced by significantly lower engagement scores for both active learning and paying attention. The results show that online versus face-to-face delivery of the computer science course can be more efficient in terms of student engagement, and a similar performance score as in the face-to-face mode can be achieved with less effort to be present at school. In addition, it is evident that female students need more support for greater engagement when the mode of delivery must be face-to-face.

1. Introduction

In information technology (IT) education, research between face-to-face and online modes of delivery has intensified with the rise of distance education during the COVID-19 pandemic. The purpose of this study is to investigate the impact of course delivery method — online versus face-to-face — on student engagement and success in an information technology course, as well as to examine gender differences.

2. Literature

Student engagement is a very important indicator of academic achievement and learning outcomes (Cigdem et al., 2024; Çiğdem & Öncü, 2023; Fredricks et al., 2004; Hutain & Michinov, 2022). Therefore, to improve student outcomes, it is essential to measure student engagement (Cigdem et al., 2024). Fredricks et al. (2004) define participation as behavioral, emotional, and cognitive. Behavioral engagement includes

* Corresponding author. Unaffiliated, Türkiye.
e-mail address: merwecolakoglu@icloud.com

Doi: http://doi.org/10.31681/jetol.1508735
Received 2 Jul 2024; Revised 19 Sep 2024; Accepted 19 Sep 2024
ISSN: 2618-6586.

compliance with school rules, study efforts, and active participation in academic activities as well as social and extracurricular activities. Emotional engagement includes how students feel about school and other students and their affective involvement with both. Finally, cognitive engagement is students' commitment to their own learning, their self-regulation, i.e. taking on the task of learning. These dimensions and their components are interrelated. For example, feeling positive about learning catalyzes behavioral engagement in coursework and increases cognitive engagement (Martin & Borup, 2022; Saqr et al., 2023).

The popularity of online learning has been growing, increasingly recently. It has become an important field of study, especially after the COVID-19 pandemic. Despite this growing popularity, many students may face challenges that prevent them from taking full advantage of online learning opportunities (Freidhoff, 2021; Martin & Borup, 2022; Trust & Whalen, 2020). One such challenge is student engagement. Online student engagement with coursework can be hindered by the limitations of communication opportunities between instructor and student (Martin & Borup, 2022). According to Johnson et al. (2015), online courses allow students to access materials from anywhere and anytime, making education more inclusive for individuals with different schedules and responsibilities. However, this mode also requires robust technological tools and a stable internet connection, which can be a barrier for some populations, especially in less urbanized areas. And yet, these are not the only limitations that may prevent students from fully engaging in academic activities.

While the importance of online learning has increased at all levels of education, learner engagement is known to be lower than face-to-face learning in general (Martin & Borup, 2022). Allen and Seaman (2017) emphasize that online learning can be a bridge for students who may face barriers in accessing education due to geographical and financial constraints. On that account, Zhu et al. (2023) investigated how different delivery methods affect student engagement and found that active participation in both environments leads to positive academic outcomes. However, Shastri and Hogan (2024) found that students who participated in face-to-face classes showed higher levels of engagement compared to students who participated online classes, and that face-to-face interactions tend to promote better learning practices and engagement (Okyere et al., 2024). Moreover, face-to-face course delivery generally leads to better academic performance and engagement (Raimondi et al., 2023; Villamor et al., 2024).

Previous research has examined how studying in various educational settings can contribute to student engagement and achievement (Bettinger et al., 2017; Elshami et al., 2022; Fishman et al., 2013; Zen et al., 2022; Zhu et al., 2023). It has also shown a consistently positive relationship between engagement and achievement at all levels of education (Li & Lerner, 2011). Many studies have compared student achievement in online and face-to-face environments (Alarifi & Song, 2024; Bettinger et al., 2017; Fischer et al., 2020; Iglesias-Pradas et al., 2021). Some studies have shown that face-to-face education is superior to online education. For example, students taking online courses tended to achieve slightly lower academic results in the classroom than their peers taking face-to-face courses (Bettinger et al., 2017; Fischer et al., 2020). On the other hand, some studies have revealed that students taking online courses perform better than students taking face-to-face courses (Gonzalez et al., 2020; Iglesias-Pradas et al., 2021).

According to research, the effectiveness of both modes in student engagement and student achievement is noticeable in terms of gender differences. Studies indicate that both modes can affect male and female students differently (Khan & Khan, 2024; Ping et al., 2024). Regarding using IT and developing IT skills, Qazi et al. (2022) claim that boys have a more positive view and use them more effectively than girls. Moreover, Zen et al. (2022) compared online and face-to-face learning, noting that both modes can encourage engagement but through different mechanisms such as project-based learning and interactive technologies in online environments. In a well-designed online environment, learning may not be different from face-to-face learning (Elshami et al., 2022). Still, some studies have emphasized that students show higher satisfaction with face-to-face attendance (Fishman et al., 2013).

Based on the purpose of the study, as stated previously, the main research questions that were investigated are:

a) How do online and face-to-face delivery methods compare regarding their effect on student engagement and achievement in an information technology course?

b) What are the gender differences in engagement and achievement between online and face-to-face course delivery?

The significance of this study is in that it addresses the evolving landscape of education, particularly in the wake of the COVID-19 pandemic, which has significantly increased the prevalence of online learning. Understanding how different delivery methods — online versus face-to-face — affect student engagement and achievement is crucial for educators and policymakers aiming to optimize educational outcomes. Additionally, examining gender differences in these contexts can provide valuable insights into tailoring educational strategies to support all students effectively. As educational institutions continue to adapt to new technologies and methodologies, this study will contribute to developing more effective, inclusive, and engaging learning environments.

3. Methodology

In this section, the research model, data collecting tools, sampling, data analysis are mentioned.

3.1. Research Model/Design

In this quasi-experimental study, the level of student engagement in an information technology course was measured and compared for two consecutive years in a freshman sample from a school of education. The course was taught online in the first year and face-to-face in the second year by the same instructor. The content and teaching methods of the two versions of the course were completely identical except for the delivery mode. When stating that they were completely identical, it is important to note that the two versions of the course were carried out in the same way by the instructor, but some instructional variations are unavoidable as it is not possible to teach something exactly the same way as the other.

3.2. Data Collecting Tools

Data were collected using a survey that included a student engagement scale as well as midterm and final exams.

The engagement scale, developed by Öncü (2015), was used to measure students' level of academic engagement in their coursework. It consisted of 8 Likert-type items with options ranging from 1 = "never" to 7 = "always", and two factors: paying attention (4 items) and active learning (4 items). Paying attention was measured by questions such as "I listened intensively to the lectures," and a high score on this dimension meant that the student was highly focused on the coursework, that he or she was immersed in the course. Active learning was measured by questions such as "I tried to answer the teacher's questions during discussions," and a high score on this dimension meant that the student was enthusiastically involved in the coursework. The scale was administered two times a semester each year, one during the administration of midterms and once during the administration of the final exam.

To determine the students' course achievement levels, two exams were administered in each of the delivery mode. Exams in the online and face-to-face deliveries were comparable forms of a midterm (one with 27 items, the other with 25 items) and a final exam (both with 48 items) of the Information Technologies course developed by the course instructor and administered in two different years during the respective time periods. The exams were administered face-to-face. The questions on the exam forms were multiple-choice, each with three wrong options and one correct option.

3.3. Sampling or Study Group

There were a total of 129 first-year students, 62 in the online mode and 67 in the face-to-face mode. Naturally, the students who took the online course were different than those who took the face-to-face course. It was not possible to know the students' facilities to access to the Internet and whether they had computers in the online delivery mode. It was assumed in this study that each student was able to reasonably access to the course and study the materials.

3.4. Data Analysis

Mean scores were calculated for "paying attention" and "active learning" engagement. In the following sections, these engagement dimension scores have been identified by the terms *ATTENTION* and *PARTICIPATION* in capital letters for ease of reference. Exam scores were calculated based on the number of correct answers and transformed to range from 0 to 100, with 100 indicating that the student answered all questions correctly. In the following sections, exam scores are identified by the term *ACHIEVEMENT* in capital letters. Subscript identifiers were used to identify the timing of the scores, as in $ATTENTION_{MIDTERM}$, $ACHIEVEMENT_{FINAL}$.

Because the data showed non-normal distributions for some of the dependent variables (as summarized in the Results section), non-parametric analyses were used. The Mann–Whitney U test was the main form of analysis for group comparisons.

4. Findings and Discussions

This section begins with tests of normality to determine the distribution of the data collected data, proceeds with the presentation of the descriptive statistics results, and then continues with the results organized according to the research questions.

4.1. Normality Tests

Kolmogorov–Smirnow and Shapiro–Wilk tests were performed to assess the normality of the data distribution. The results are presented in Table 1. The Shapiro–Wilk test is recommended for small samples (n≤50). The Kolmogorov–Smirnov test is recommended for larger samples (n>50). Accordingly, the results indicate that two data sets are not normally distributed, namely the $ATTENTION_{MIDTERM}$ and $ACHIEVEMENT_{MIDTERM}$. Therefore, to facilitate the interpretation of the results, all statistics were performed in a non-parametric manner.

Table 1.

Tests of normality.

	Kolmogorov-Smirnov[a]			**Shapiro-Wilk**		
	Statistic	df	Sig.	Statistic	df	Sig.
$ATTENTION_{MIDTERM}$	.075	95	.200*	.988	95	.513
$ATTENTION_{FINAL}$	.118	108	**<.001**	.968	108	**.011**
$PARTICIPATION_{MIDTERM}$	.091	95	.051	.943	95	**<.001**
$PARTICIPATION_{FINAL}$	.068	108	.200*	.973	108	**.026**
$ACHIEVEMENT_{MIDTERM}$	.097	129	**.005**	.974	129	**.014**
$ACHIEVEMENT_{FINAL}$	.064	125	.200*	.983	125	.116

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction.
Bold: Highlights significant results.

4.2. Descriptive Statistics

Table 2 provides descriptive information about the study participants. The table show that before any advanced statistical tests, except for $ATTENTION_{MIDTERM}$, the results favored face-to-face learners.

Table 2.

Descriptive statistics.

		Online			Face to Face			Total		
		Male (n=19)	Female (n=43)	Total (n=62)	Male (n=19)	Female (n=48)	Total (n=67)	Male (n=38)	Female (n=91)	Total (n=129)
ATTENTION$_{MIDTERM}$	M	3.92	4.54	**4.34**	4.54	4.15	**4.27**	4.22	4.34	4.30
	SD	1.22	1.02	1.11	1.03	1.31	1.23	1.16	1.18	1.17
	Min	2.50	2.00	2.00	1.50	1.25	1.25	1.50	1.25	1.25
	Max	6.25	6.50	6.50	5.50	6.75	6.75	6.25	6.75	6.75
	Va. n	15	32	47	14	34	48	29	66	95
ATTENTION$_{FINAL}$	M	4.53	4.90	**4.77**	5.50	4.53	**4.80**	5.03	4.68	4.79
	SD	1.29	1.31	1.30	0.67	1.21	1.17	1.12	1.26	1.22
	Min	2.75	1.50	1.50	4.25	1.25	1.25	2.75	1.25	1.25
	Max	7.00	6.75	7.00	7.00	6.75	7.00	7.00	6.75	7.00
	Va. n	16	31	47	17	44	61	33	75	108
PARTICIPATION$_{MIDTERM}$	M	2.40	3.01	**2.81**	4.05	3.56	**3.70**	3.20	3.29	3.26
	SD	1.31	1.46	1.43	1.74	1.81	1.79	1.72	1.66	1.67
	Min	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Max	5.00	6.00	6.00	6.25	6.75	6.75	6.25	6.75	6.75
	Va. n	15	32	47	14	34	48	29	66	95
PARTICIPATION$_{FINAL}$	M	2.92	3.30	**3.17**	4.91	3.88	**4.16**	3.95	3.64	3.73
	SD	1.63	1.58	1.59	1.21	1.42	1.43	1.73	1.51	1.58
	Min	1.00	1.00	1.00	2.75	1.00	1.00	1.00	1.00	1.00
	Max	7.00	6.75	7.00	7.00	6.75	7.00	7.00	6.75	7.00
	Va. n	16	31	47	17	44	61	33	75	108
ACHIEVEMENT$_{MIDTERM}$	M	45.94	41.18	**42.64**	46.49	45.62	**45.86**	46.22	43.52	44.32
	SD	10.03	10.79	10.71	9.77	11.23	10.77	9.77	11.19	10.82
	Min	29.17	25.00	25.00	33.33	25.00	25.00	29.17	25.00	25.00
	Max	58.33	64.58	64.58	72.92	68.75	72.92	72.92	68.75	72.92
	Va. n	19	43	62	19	48	67	38	91	129
ACHIEVEMENT$_{FINAL}$	M	73.46	68.43	**69.99**	73.05	71.92	**72.24**	73.25	70.33	71.19
	SD	10.65	11.89	11.66	10.23	11.15	10.83	10.29	11.56	11.24
	Min	55.56	40.74	40.74	52.00	40.00	40.00	52.00	40.00	40.00
	Max	88.89	88.89	88.89	92.00	96.00	96.00	92.00	96.00	96.00
	Va. n	18	40	58	19	48	67	37	88	125

Va. n: Valid n (number of responses).
Bold: Some comparable statistics are shown in bold to facilitate overall comparison.

While there were data from 62 students who participated in the study in the online mode of delivery, only 47 responded to the surveys and 58 took the final exam (see Table 2). In the face-to-face group, there were data from 67 students with varying numbers of survey respondents. All of them took the exams.

4.3. Comparisons of Engagement and Achievement Scores Across Modes of Delivery

Several Mann–Whitney U Test sessions were conducted to compare the groups. The results of the tests are summarized in Table 3.

According to the Mann–Whitney U test results, students were equally engaged in terms of paying attention in both modes of delivery. However, they were not equally engaged in active learning (*PARTICIPATION*). The face-to-face students reported being significantly more active learners throughout the course, both at midterm and final exams.

Slightly higher performance scores in favor of face-to-face learners can be observed in both midterms and finals (*ACHIEVEMENT$_{MIDTERM}$ and ACHIEVEMENT$_{FINAL}$*). Still the differences between the delivery modes did not prove to be significant.

Table 3.

Summary of Mann–Whitney U Test results across modes of delivery.

Null Hypothesis	Sig.[a,b]	Decision
1. The distribution of *ATTENTION*$_{MIDTERM}$ is the same across categories of Online vs. Face-to-Face delivery mode.	.911	Retain the null hypothesis.
2. The distribution of *ATTENTION*$_{FINAL}$ is the same across categories of Online vs. Face-to-Face delivery mode.	.894	Retain the null hypothesis.
3. The distribution of *PARTICIPATION*$_{MIDTERM}$ is the same across categories of Online vs. Face-to-Face delivery mode.	**.015**	**Reject the null hypothesis.**
4. The distribution of *PARTICIPATION*$_{FINAL}$ is the same across categories of Online vs. Face-to-Face delivery mode.	**.001**	**Reject the null hypothesis.**
5. The distribution of *ACHIEVEMENT*$_{MIDTERM}$ is the same across categories of Online vs. Face-to-Face delivery mode.	.109	Retain the null hypothesis.
6. The distribution of *ACHIEVEMENT*$_{FINAL}$ is the same across categories of Online vs. Face-to-Face delivery mode.	.271	Retain the null hypothesis.

a. The significance level is .050.
b. Asymptotic significance is displayed.
Bold: Highlights significant results.

The detailed test results regarding the significant differences are presented below:

PARTICIPATION$_{MIDTERM}$ *across Online vs. Face-to-Face delivery*

According to the statistical comparisons (see Table 4), the face-to-face learners were significantly more engaged in the active learning activities than the online learners by the time the midterms were administered.

Table 4.

Mann–Whitney U Test results for *PARTICIPATION*$_{MIDTERM}$ across online and face-to-face modes of delivery.

Independent-Samples Mann–Whitney U Test Summary	
Total N	95
Mann–Whitney U	1455.000
Wilcoxon W	2631.000
Test Statistic	1455.000
Standard Error	134.051
Standardized Test Statistic	2.439
Asymptotic Sig. (2-sided test)	**.015**

Bold: Highlights significant results.

Figure 1 shows that the engagement of face-to-face learners was a bit more consistent, while the engagement of online learners in active learning (*PARTICIPATION*$_{MIDTERM}$) was slightly skewed toward the ceiling.

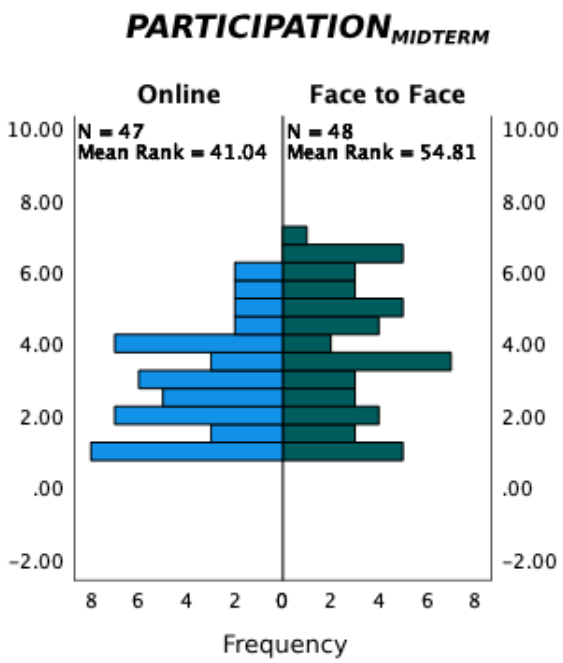

Fig. 1. Comparison of online and face-to-face learners in terms of *PARTICIPATION* by the end of midterms.

$PARTICIPATION_{FINAL}$ across Online vs. Face-to-Face delivery

According to the statistical comparisons (see Table 5), similar to the midterm results, the face-to-face learners were significantly more engaged in the active learning process than the online learners by the time the final exams were administered ($PARTICIPATION_{FINAL}$), similar to the results at the time the midterm exams were administered.

Table 5.

Mann–Whitney U Test results for $PARTICIPATION_{FINAL}$ across online and face-to-face modes of delivery.

Independent-Samples Mann–Whitney U Test Summary	
Total N	108
Mann–Whitney U	1967.000
Wilcoxon W	3858.000
Test Statistic	1967.000
Standard Error	161.116
Standardized Test Statistic	3.311
Asymptotic Sig. (2-sided test)	**.001**

Bold: Highlights significant results.

Figure 2 shows that face-to-face learners' engagement ($PARTICIPATION_{FINAL}$) was more consistent, while online learners' engagement in active learning was slightly skewed toward the ceiling.

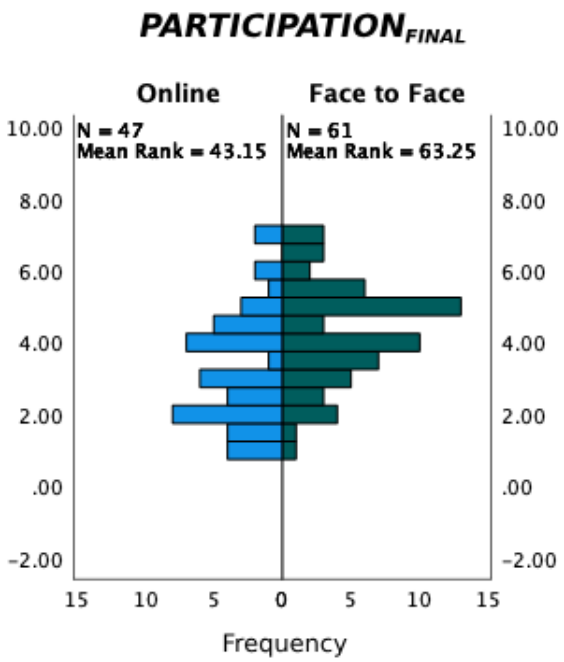

Fig. 2. Comparison of online and face-to-face learners regarding active learning *PARTICIPATION* by the end of final exams.

4.4. Comparisons of Engagement and Achievement Scores Across Genders

Male and female students were also compared on their engagement and exam scores. The results of the Mann–Whitney U tests (see Table 6) overall indicate no difference between the sexes on any of the dependent variables.

Table 6.

Summary of Mann–Whitney U Test results by gender.

Null Hypothesis	Sig.a,b	Decision
1. The distribution of $ATTENTION_{MIDTERM}$ is the same across categories of Gender.	.731	Retain the null hypothesis.
2. The distribution of $ATTENTION_{FINAL}$ is the same across categories of Gender.	.206	Retain the null hypothesis.
3. The distribution of $PARTICIPATION_{MIDTERM}$ is the same across categories of Gender.	.789	Retain the null hypothesis.
4. The distribution of $PARTICIPATION_{FINAL}$ is the same across categories of Gender.	.385	Retain the null hypothesis.
5. The distribution of $ACHIEVEMENT_{MIDTERM}$ is the same across categories of Gender.	.150	Retain the null hypothesis.
6. The distribution of $ACHIEVEMENT_{FINAL}$ is the same across categories of Gender.	.250	Retain the null hypothesis.

a. The significance level is .050.
b. Asymptotic significance is displayed.

However, separate analyses within face-to-face learners revealed that females were significantly less engaged by the time the final exams were administered (Table 7).

Table 7.

Summary of Mann–Whitney U Test results by gender within face-to-face learners.

Null Hypothesis	Sig.[a,b]	Decision
1. The distribution of $ATTENTION_{MIDTERM}$ is the same across categories of Gender.	.187	Retain the null hypothesis.
2. The distribution of $ATTENTION_{FINAL}$ is the same across categories of Gender.	**.002**	**Reject the null hypothesis.**
3. The distribution of $PARTICIPATION_{MIDTERM}$ is the same across categories of Gender.	.340	Retain the null hypothesis.
4. The distribution of $PARTICIPATION_{FINAL}$ is the same across categories of Gender.	**.014**	**Reject the null hypothesis.**
5. The distribution of $ACHIEVEMENT_{MIDTERM}$ is the same across categories of Gender.	.743	Retain the null hypothesis.
6. The distribution of $ACHIEVEMENT_{FINAL}$ is the same across categories of Gender.	.795	Retain the null hypothesis.

a. The significance level is .050.
b. Asymptotic significance is displayed.
Bold: Highlights significant results.

$ATTENTION_{FINAL}$ across Genders in the Face-to-Face Delivery

According to the statistical comparisons (see Table 8), the male learners in the face-to-face mode were paying significantly more attention ($ATTENTION_{FINAL}$) to the course than the female learners by the time the final exams were administered.

Table 8.

Mann–Whitney U Test results for $ATTENTION_{FINAL}$ across genders in the face-to-face mode of delivery.

Independent-Samples Mann–Whitney U Test Summary	
Total N	61
Mann–Whitney U	183.500
Wilcoxon W	1173.500
Test Statistic	183.500
Standard Error	61.937
Standardized Test Statistic	-3.076
Asymptotic Sig. (2-sided test)	**.002**

Bold: Highlights significant results.

Figure 3 shows that the mean rank scores ($ATTENTION_{FINAL}$) of the males in the face-to-face mode of delivery were significantly higher than those of the female students while the graphs showed similar distribution patterns.

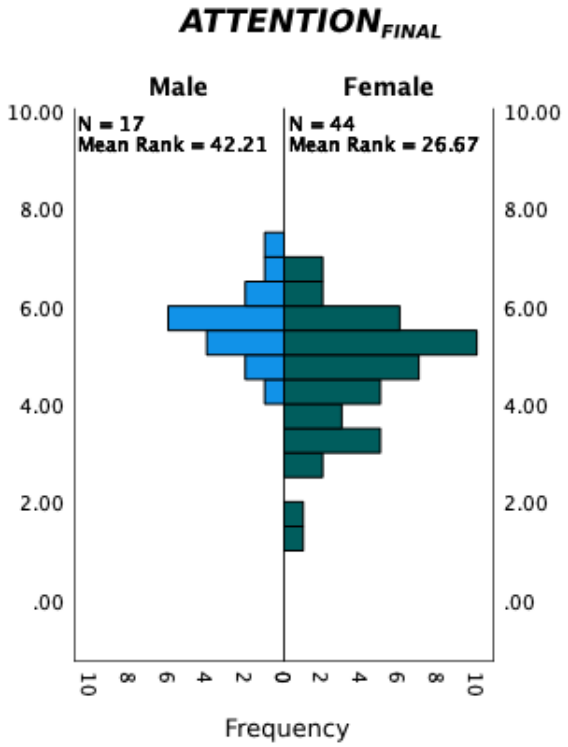

Fig. 3. Comparison of male and female learners in terms of *ATTENTION* by the end of final exams in the face-to-face group.

$PARTICIPATION_{FINAL}$ across Genders in the Face-to-Face Delivery

According to the statistical comparisons (see Table 9), the male learners in the face-to-face mode were significantly more engaged in the active learning activities ($PARTICIPATION_{FINAL}$) than the female learners by the time the final exams were administered.

Table 9.

Mann–Whitney U Test results for $PARTICIPATION_{FINAL}$ across genders in the face-to-face mode of delivery.

Independent-Samples Mann–Whitney U Test Summary	
Total N	61
Mann–Whitney U	221.500
Wilcoxon W	1211.500
Test Statistic	221.500
Standard Error	62.008
Standardized Test Statistic	-2.459
Asymptotic Sig. (2-sided test)	**.014**

Bold: Highlights significant results.

Figure 4 shows that the mean rank scores ($PARTICIPATION_{FINAL}$) of the males in the face-to-face mode of delivery were significantly higher than those of the female students while the graphs showed similar distribution patterns.

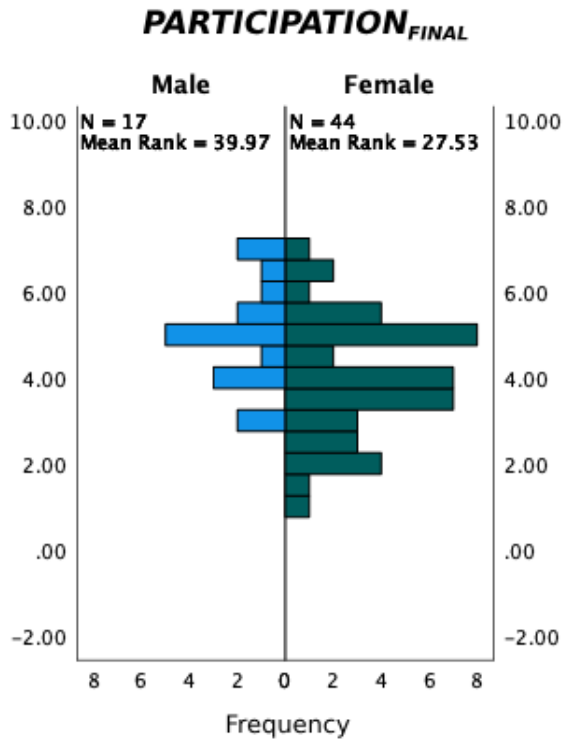

Fig. 4. Comparison of male and female learners in terms of *PARTICIPATION* by the end of final exams in the face-to-face group.

5. Conclusion and Suggestions

The present study compared student engagement and achievement in online versus face-to-face instructional modes in a freshman information technology course. Contrary to the initial expectation that face-to-face instruction engagement levels would be higher, the results revealed no significant differences in students' paying attention engagement across the two modes. However, face-to-face students demonstrated significantly higher active learning engagement, aligning with the literature (Martin & Borup, 2022). This suggests that the physical presence and real-time interaction inherent in face-to-face learning environments may foster more active participation.

Despite this increased engagement, the two groups had no significant difference in academic achievement. This contradicts the findings of the majority of previous research, such as that by Bettinger et al. (2017), which showed that instructional effectiveness is indeed compromised in online learning environments. Our findings suggest that while face-to-face interaction may be associated with enhanced engagement, it does not necessarily translate into higher academic performance. It may also indicate that students put more effort into achieving the same goal in face-to-face instruction.

Additionally, gender differences were observed within the face-to-face instructional mode. Male students showed significantly higher levels of both paying attention and active learning engagement by the end of the course, compared to their female counterparts. This trend aligns with some literature indicating gender differences in classroom engagement (Khan & Khan, 2024; Ping et al., 2024), but the reasons behind these differences warrant further investigation.

In conclusion, while face-to-face instruction promotes higher active learning engagement, it does not significantly impact academic achievement compared to online instruction. These findings have important implications for educational institutions as they consider designing and implementing of instructional strategies that maximize both engagement and learning outcomes. Future research should explore the underlying factors contributing to gender differences in engagement and examine how online learning environments can be enhanced to foster greater active participation.

6. Recommendations

The results suggest that online delivery of the Information Technology course may be more efficient in terms of engagement, with less effort required to be present in person at the school, resulting in a similar performance score to the face-to-face delivery. In addition, when the delivery mode has to be face-to-face, female students need more support to be more engaged. However, they still achieved a similar level of achievement as the male students.

Given the premise that the more engaged students are, the more successful they will be (Orthner et al., 2010; Picton et al., 2018; Reyes et al., 2012), if students in the online mode are supported to improve their engagement, they may be more successful. Similarly, given that females tend to underperform in information technology (Qazi et al., 2022; Zhang et al., 2021), if female students are supported to improve their engagement, they may be even more successful in the face-to-face mode.

References

Alarifi, B. N., & Song, S. (2024). Online vs in-person learning in higher education: effects on student achievement and recommendations for leadership. *Humanities and Social Sciences Communications*, *11*(1), 86. https://doi.org/10.1057/s41599-023-02590-1

Allen, I. E., & Seaman, J. (2017). *Digital Learning Compass: Distance Education Enrollment Report 2017*.

Bettinger, E. P., Fox, L., Loeb, S., & Taylor, E. S. (2017). Virtual Classrooms: How Online College Courses Affect Student Success. *American Economic Review*, *107*(9), 2855–2875. https://doi.org/10.1257/aer.20151193

Çiğdem, H., & Öncü, S. (2023). *Learner Engagement in the Metaverse* (pp. 17–36). https://doi.org/10.4018/978-1-6684-6513-4.ch002

Cigdem, H., Ozturk, M., Karabacak, Y., Atik, N., Gürkan, S., & Aldemir, M. H. (2024). Unlocking student engagement and achievement: The impact of leaderboard gamification in online formative assessment for engineering education. *Education and Information Technologies*. https://doi.org/10.1007/s10639-024-12845-2

Elshami, W., Taha, M. H., Abdalla, M. E., Abuzaid, M., Saravanan, C., & Al Kawas, S. (2022). Factors that affect student engagement in online learning in health professions education. *Nurse Education Today*, *110*, 105261. https://doi.org/10.1016/j.nedt.2021.105261

Fischer, C., Xu, D., Rodriguez, F., Denaro, K., & Warschauer, M. (2020). Effects of course modality in summer session: Enrollment patterns and student performance in face-to-face and online classes. *The Internet and Higher Education*, *45*, 100710. https://doi.org/10.1016/j.iheduc.2019.100710

Fishman, B., Konstantopoulos, S., Kubitskey, B. W., Vath, R., Park, G., Johnson, H., & Edelson, D. C. (2013). Comparing the Impact of Online and Face-to-Face Professional Development in the Context of Curriculum Implementation. *Journal of Teacher Education*, *64*(5), 426–438. https://doi.org/10.1177/0022487113494413

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School Engagement: Potential of the Concept, State of the Evidence. *Review of Educational Research*, *74*(1), 59–109. https://doi.org/10.3102/00346543074001059

Freidhoff, J. R. (2021). *Michigan's k-12 virtual learning effectiveness report 2019-20*.

Gonzalez, T., de la Rubia, M. A., Hincz, K. P., Comas-Lopez, M., Subirats, L., Fort, S., & Sacha, G. M. (2020). Influence of COVID-19 confinement on students' performance in higher education. *PLOS ONE*, *15*(10), e0239490. https://doi.org/10.1371/journal.pone.0239490

Hutain, J., & Michinov, N. (2022). Improving student engagement during in-person classes by using functionalities of a digital learning environment. *Computers & Education*, *183*, 104496. https://doi.org/10.1016/j.compedu.2022.104496

Iglesias-Pradas, S., Hernández-García, Á., Chaparro-Peláez, J., & Prieto, J. L. (2021). Emergency remote teaching and students' academic performance in higher education during the COVID-19 pandemic: A case study. *Computers in Human Behavior*, *119*, 106713. https://doi.org/10.1016/j.chb.2021.106713

Johnson, H. P., Mejia, M. C., & Cook, K. (2015). *Successful online courses in California's community colleges*. Public Policy Institute.

Khan, M. O., & Khan, S. (2024). Influence of online versus traditional learning on EFL listening skills: A blended mode classroom perspective. *Heliyon*, *10*(7), e28510. https://doi.org/10.1016/j.heliyon.2024.e28510

Li, Y., & Lerner, R. M. (2011). Trajectories of school engagement during adolescence: Implications for grades, depression, delinquency, and substance use. *Developmental Psychology*, *47*(1), 233–247. https://doi.org/10.1037/a0021307

Martin, F., & Borup, J. (2022). Online learner engagement: Conceptual definitions, research themes, and supportive practices. *Educational Psychologist*, *57*(3), 162–177. https://doi.org/10.1080/00461520.2022.2089147

Okyere, C. Y., Otchere, F., Darko, J. K., & Osei, C. K. (2024). COVID-19 and child education outcomes in Southern Ghana. *Heliyon*, *10*(4), e26238. https://doi.org/10.1016/j.heliyon.2024.e26238

Öncü, S. (2015). Online Peer Evaluation for Assessing Perceived Academic Engagement in Higher Education. *EURASIA Journal of Mathematics, Science and Technology Education*, *11*(3). https://doi.org/10.12973/eurasia.2015.1343a

Orthner, D. K., Akos, P., Rose, R., Jones-Sanpei, H., Mercado, M., & Woolley, M. E. (2010). CareerStart: A Middle School Student Engagement and Academic Achievement Program. *Children & Schools*, *32*(4), 223–234. https://doi.org/10.1093/cs/32.4.223

Picton, C., Kahu, E. R., & Nelson, K. (2018). 'Hardworking, determined and happy': first-year students' understanding and experience of success. *Higher Education Research & Development*, *37*(6), 1260–1273. https://doi.org/10.1080/07294360.2018.1478803

Ping, C. S., Tahir, L. M., Rosli, M. S., Atan, N. A., & Ali, M. F. (2024). Challenges and barriers to e-leadership participation: Examining the perspectives of Malaysian secondary school teachers.

Education and Information Technologies, *29*(8), 10329–10367. https://doi.org/10.1007/s10639-023-12206-5

Qazi, A., Hasan, N., Abayomi-Alli, O., Hardaker, G., Scherer, R., Sarker, Y., Kumar Paul, S., & Maitama, J. Z. (2022). Gender differences in information and communication technology use & skills: a systematic review and meta-analysis. *Education and Information Technologies*, *27*(3), 4225–4258. https://doi.org/10.1007/s10639-021-10775-x

Raimondi, C., Pratto, M., Otegui, X., Fernández, L., & Luna, C. (2023). *Analysis of The Perceived Usefulnes of Recorded Lectures in Students of The School of Engineering in Uruguay*. 7180–7186. https://doi.org/10.21125/iceri.2023.1785

Reyes, M. R., Brackett, M. A., Rivers, S. E., White, M., & Salovey, P. (2012). Classroom emotional climate, student engagement, and academic achievement. *Journal of Educational Psychology*, *104*(3), 700–712. https://doi.org/10.1037/a0027268

Saqr, M., López-Pernas, S., Helske, S., & Hrastinski, S. (2023). The longitudinal association between engagement and achievement varies by time, students' profiles, and achievement state: A full program study. *Computers & Education*, *199*, 104787. https://doi.org/10.1016/j.compedu.2023.104787

Shastri, K., & Hogan, B. (2024). *Education Delivery Modes: A Post-COVID Study of Traditinal and Online Classes in Managerial Accounting*. 2.

Trust, T. , & Whalen, J. (2020). Should teachers be trained in emergency remote teaching? Lessons learned from the COVID-19 pandemic. *Journal of Technology and Teacher Education*, *28*(2), 189–199.

Villamor, A. L., Keith, L., Cabig, L., Eryne, N., Romero, O., Guevarra, D. T., Pamintuan, J. A., Santos, J. M., Tadeo, A., Aquino, G. T., Montemayor, J. N., Louise, J., & Marcaida, M. (2024). Measuring The Impact of Face-To-Face Learning on Humss Students' School Productivity. *Ignatian International Journal for Multidisciplinary Research*, *2*. https://doi.org/10.5281/zenodo.10983060

Zen, Z., Reflianto, Syamsuar, & Ariani, F. (2022). Academic achievement: the effect of project-based online learning method and student engagement. *Heliyon*, *8*(11), e11509. https://doi.org/10.1016/j.heliyon.2022.e11509

Zhang, Y., Gros, T., & Mao, E. (2021). Gender Disparity in Students' Choices of Information Technology Majors. *Business Systems Research Journal*, *12*(1), 80–95. https://doi.org/10.2478/bsrj-2021-0006

Zhu, L., Defazio, J., Huang, E., & Hook, S. (2023). The Impact of Attendance and Participation on Undergraduate Student Performance in Face-to-Face and Online Courses. *IUPUI ScholarWorks*.