

An Empirical Study on Gender Differences of College Students' Perceptions in Online Learning

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Abstract: The swift advancement of digital technology is leading to the mainstreaming of online education as a modality of instruction, but the influence of gender differences therein is becoming more and more prominent, posing a potential threat to educational equity. This study aims to deeply analyze gender differences in college students' perceptions of online learning to promote educational equity and quality. To assess their perceptions of online learning quantitatively, the study has drawn on and improved the existing measurement scales by adding new dimensions of students' online perceptions. This study randomly recruited college students (n=189) as the research sample and used an empirical study methodology to methodically gather and examine data to confirm the disparities in how students of various genders perceive online learning. According to the study, there are notable distinctions between how male and female students interact, participate, and contribute to online learning. Female students were more likely to receive support from the instructor and construct knowledge in social interactions, while male students were more adept at independent exploratory learning. The study explains the multiplicity and complexity of gender differences in college students' perceptions of online education and gives recommendations for research findings.

Keywords: Gender Differences, Perceptions, Online Learning.

1. Introduction

Fuelled by the rapid development of digital technology and the penetration of the educational arena, online learning has become the 'new normal', with an increasing scale of use and necessity in education [1, 2]. The widespread use of online learning is making profound impacts on the situation of all stakeholders. However, online education creates a new digital divide as well as inequality challenges that need to be addressed. There have always been differences regarding technology use in education between male and female students, and students' attitudes and opinions of online education are seen to be the most likely to represent these differences [3, 4]. The gender dimension of the digital divide is being further widened by gender inequities, and as long as the crisis persists, players in the public and commercial sectors must respond quickly to address it. However, there is very little focus on gender disparities in the growing field of online learning. Thus, more research is necessary to raise educational standards, promote equity in this setting, and strengthen the foundation of the educational system.

This study aims to examine how college students perceive gender disparities in online learning and to offer recommendations for improving and expanding the field of online education. This study specifically focuses on responding to the research questions as follows:

- a. What aspects of online learning are now perceived negatively by college students?
- b. How do male and female students view online learning differently from one another?

2. Theoretical Basis and Research Design

2.1. Evolution of Research on Gender Differences in Online Learning

Extensive research has established that students exhibit gender disparities in their perception of online education, and these disparities manifest in varying forms across different eras of research. In the initial stages of the twentieth century, when technology was predominantly male-dominated, the exploration was primarily centered on technological disparities [5]. However, as information technology advanced and became increasingly accessible to both genders, the accessibility to online tools and electronic facilities converged for both male and female students [6]. Despite this convergence, the challenge of gender differences has persisted and even intensified. In the context of the explosive growth of online education, the disparities that emerge in students' perceptions continue to contribute to unequal educational outcomes [7]. The current exploration of gender differences in online learning has broadened its scope to encompass areas such as student performance, motivations, perceptions, study habits, and communication behaviors, reflecting a more comprehensive and nuanced understanding of the complex gender dynamics within online learning environments [8].

Previous studies have illuminated distinct differences among genders in communication modalities, information exchange methods, and learning behaviors. These findings also point to apparent disparities in the areas of study pursued by female students and men in college [1, 9]. Owing to the inherent communication disparities between female students and men in online environments, their approaches to participation and contribution to learning activities [10, 11].

2.2. Measurement Scale of Students' Perceptions of Online Learning

Researchers have delved into various methods to gauge students' perspectives on online learning and have crafted corresponding scales. McVay's measurement scale stands out as a noteworthy classic [12]. Subsequently, scholars have rigorously tested, reviewed, and refined this scale. Smith, Murphy, and Mahoney harnessed factor analysis to identify two pivotal factors from McVay's scale: "e-learning comfort" and "learning self-management." Later, Hung, Chou, Chen, and Own took a step further by developing the Online Learning Readiness Scale (OLRS), which incorporated internet proficiency, computational skills, and students' ability to organize course materials, building upon McVay's scale (depicted in Figure 1) [13]. OLRS encompasses crucial dimensions such as self-efficacy of Internet use, learning motivation, and self-efficacy of communication within online mode. However, Kaushal et al. identified the shortcomings of the OLRS and supplemented it with new elements, thereby creating a refined scale called POSTOL (depicted in Figure 2) [14]. POSTOL serves as a comprehensive addition to the OLRS, expanding the scope of students' online perceptions to encompass dimensions like instructor characteristics, social presence, instructional design, and beliefs.

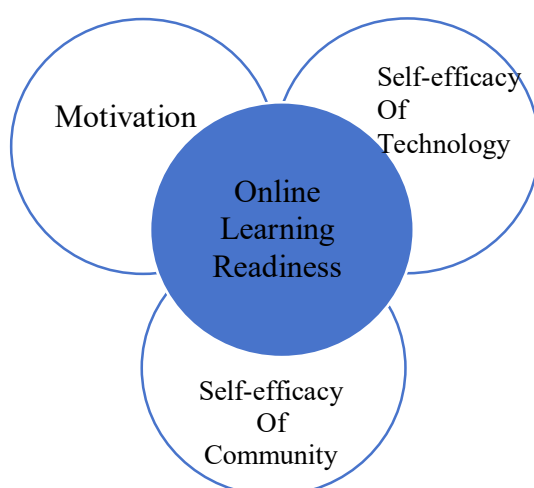


Figure 1: Dimensions of Online Learning Readiness Scale (OLRS) [13].

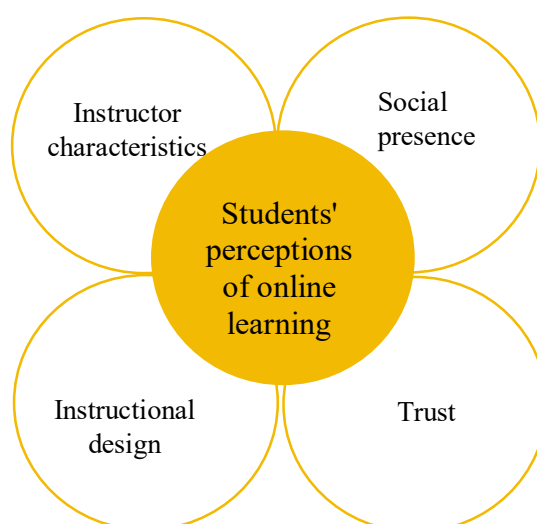


Figure 2: Dimensions of POSTOL [14].

2.3. Gender Differences from POSTOL and OLRS Structure

The learning communication paradigm of female students predominantly aligns with the foundations of constructivism, enabling them to adeptly utilize scaffolding techniques, whereas male students tend to adhere to instructions [15]. Female students' communication habits facilitate deeper exploration of knowledge and theories through dialogue, fostering collaborative course learning. Within the constructivist framework, studies have revealed gender disparities in both the OLRS and POSTOL scales.

Female students tend to seek more support from instructors compared to male students. Consequently, they are more inclined to construct knowledge through interactions with the external world, particularly with instructors. Female students hold more favorable views on instructor characteristics and social presence in online learning than male students [16].

However, female students often experience higher anxiety during tests due to the cognitive load of acquiring knowledge through communication modalities, whereas male students tend to be more relaxed [17]. As the communication paradigm of online courses evolves, it necessitates a heightened

ability to extract information from asymmetric sources. Moreover, male students demonstrate a stronger intensity in technology usage. Existing research has concurred that men harbor more positive perceptions [4, 17]. Men tend to exhibit a higher intensity in their utilization of technology, along with more favorable views and attitudes toward online learning and technological adoption. When considering technology, male students display a stronger sense of self-efficacy. Interestingly, these technology-oriented research findings among men are consistent across various countries and cultural backgrounds.

2.4. Hypotheses

This research puts forward theoretical hypotheses.

Hypothesis₁: Interaction and Collaboration Hypothesis: In the dimension of interaction and collaboration (IC), female students demonstrate higher levels of activity compared to males, and they are more inclined to receive support from instructors;

Hypothesis₂: Social Presence Hypothesis: In the dimension of social presence (SP), female students possess more favorable perceptions than males;

Hypothesis₃: Instructional Design Hypothesis: In the dimension of instructional design (ID), female students hold a more positive view than males, indicating their greater adaptability to online interactive teaching design;

Hypothesis₄: Trust Hypothesis: In the dimension of trust (T), males tend to perceive technology more positively than female students, who are likely to experience higher levels of anxiety related to technology usage;

Hypothesis₅: Motivation and Persistence Hypothesis: In the dimension of motivation and persistence (M), female students exhibit more positive perceptions than males, indicating their greater ability to persevere and maintain learning momentum;

Hypothesis₆: Self-efficacy of technology Hypothesis: In the ST dimension, males perceive more positively than female students;

Hypothesis₇: Self-efficacy of community Hypothesis: In the SC dimension, female students have more positive perceptions than males.

3. Methodology

This study recruited a random sample of 189 college students through an online survey to conduct a quantitative analysis of the following research questions: (1) Identify gender-based disparities of students' perceptions of online learning using ANOVA; (2) Explore the reasons and influencing factors behind these differences through moderator analysis.

3.1. Variables and Measurement

Students' perspective ratings of online learning are integrated into the research design, together with control factors such as age, discipline, region, and technology/internet usage. Table 1 offers a thorough summary of these variables.

3.1.1. Dependent Variables

Seven dependent variables are used to capture students' perceptions: IC (instructor characteristic), SP (social presence), ID (instructional design), T (technology), M (motivation), SC (self-efficacy of communication), and ST (self-efficacy of technology). A 5-point Likert scale is utilized to assess students' views on online learning. Students' assessments of teachers' interactivity, friendliness, punctuality, effectiveness, and capacity to meet their requirements are specifically measured by the

scale in the IC dimension. The SP component evaluates the sharing of ideas, involvement in classroom communication, and access to technology and the Internet. The ID dimension assesses how clearly the course aim is stated, how tough the course is seen by the students, and group interaction patterns. Students' perceptions of the advantages of online learning over traditional courses are captured by the T dimension. The M dimension gauges how motivated students are to learn in online classes. Lastly, students' self-efficacy in using online technology and conversing online is evaluated by the ST and SC aspects. A higher score in the relevant dimension denotes a more favorable perception.

3.1.2. Control Variables

The analytical framework presented is depicted in the following table, which comprises seven dimensions: IC (instructor characteristic perceptions), SP (social presence perceptions), ID (instructional design perceptions), M (motivation perceptions), T (trust perceptions), SC (self-efficacy in communication perceptions), and ST (self-efficacy in technology perceptions) to assess students' perspectives on online education. These dimensions exhibit notable differences among genders. Additionally, control variables such as age, region, internet usage frequency, and faculty are taken into account.

Table 1: Variable description and measurement scales.

variables	descriptions	measure scales
Students' perception	T	1= completely disagree 2= disagree 3= neither in agreement nor disagreement 4= agree 5= completely agree
	SC	
	ST	
	IC	
	SP	
	ID	
	M	
Control variables	age	num
	Region	1: city area
		2: urban area
		3: rural area
	Time of internet/technology use	1: more than 8 (hours)
		2: more than 6, and no more than 8 (hours)
		3: more than 4, and no more than 6 (hours)
		4: more than 2, and no more than 4 (hours)
		5: no more than 2 (hours)
	Discipline	1: Social Science
		2: Economic Management Disciplines
		3: Law

Table 1: (continued).

		4: Urban Planning and Architecture
		5: Art and Design
		6: Engineering and Technology
		7: Dentistry
		8: Medical Science
		9: Mathematical Science
		10: Others

3.2. Data Analysis

The following quantitative analyses have been conducted: (1) use the Analysis of Variance (ANOVA) to find gender-based characteristics in students' perceptions about online learning; (2) delve into the underlying reasons and influencing factors through moderator analysis. Complementing the quantitative approach, qualitative analysis grounded in a theoretical framework will also be utilized to interpret the data and analyze the reasons behind the findings. The specific data analysis methods are outlined below.

In this study, the single-factor ANOVA method will be employed. The F-test statistic will be examined to determine the statistical significance following a comparison of the factor total deviations. The F test statistic formula is as follows:

$$F = \frac{\text{variance between treatments}}{\text{variance within treatments}} \quad (1)$$

$$F = \frac{MS_{\text{treatments}}}{MS_{\text{error}}} = \frac{SS_{\text{treatments}}/(I-1)}{SS_{\text{error}}/(n_T-I)} \quad (2)$$

The dimension means maxima and minima will be used for gender difference comparisons as the mean reflects the average, the minima the vulnerable group, and the maxima the degree of fulfillment of the perceived potential of online education.

4. Results

4.1. RQ1--Students' Overall Perceptions of Online Learning

Upon analyzing the scores about students' perceptions of online learning, it can be observed from the statistical data (refer to Table 2 and Figures 3-4) that the majority of perception scores are greater than 3 points, indicating neither dissatisfaction nor mere satisfaction. This suggests that students have a generally positive preference for online learning. When examining the scores across various dimensions, it can be found that students hold the most positive views on Social Presence (SP), Instructor Characteristic (IC), Instructional Design (ID), and Self-Efficacy in Technology (ST), with mean scores of 3.98, 3.84, 3.80, and 3.67 respectively. These scores indicate a near-satisfaction level, suggesting that students are pleased with factors such as instructors' friendliness, interactivity, effectiveness, and timeliness; as well as their ability to access online resources, engage in idea sharing, participate in discussions, utilize interactive tools, and communicate with peers.

The scores for Self-efficacy in Communication (SC) and Motivation (M) follow closely, averaging 3.28 and 3.15 respectively, indicating average satisfaction. Among these, students seem to have a higher self-efficacy in using online technology compared to online communication. However, the average score for Trust (T) falls below 3 points, revealing that students are not fully convinced that

online learning offers more benefits than traditional methods. The median and mode scores align with these trends, indicating a similar distribution of students' perceptions across the various dimensions of online learning.

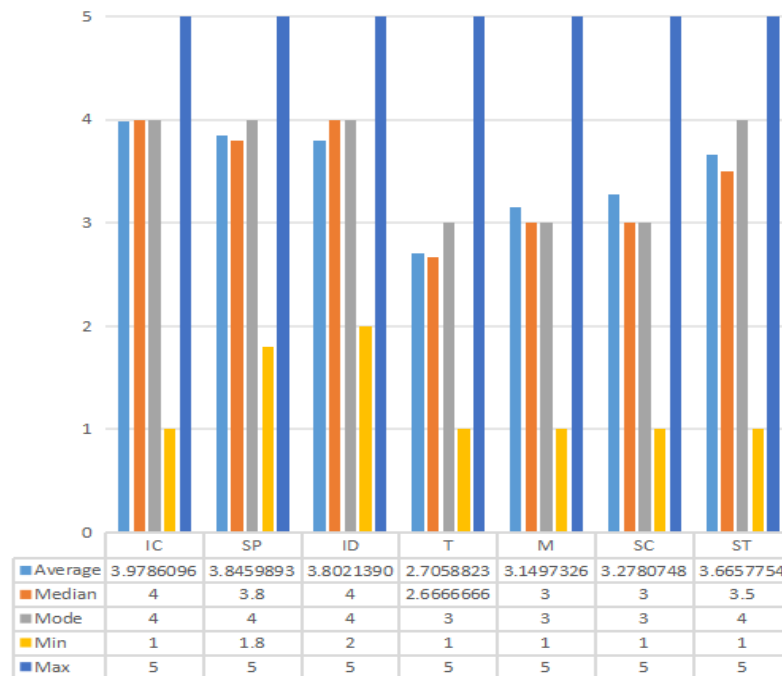


Figure 3: Graphical representation of students' perception of online education (a) (Picture credit: Original).

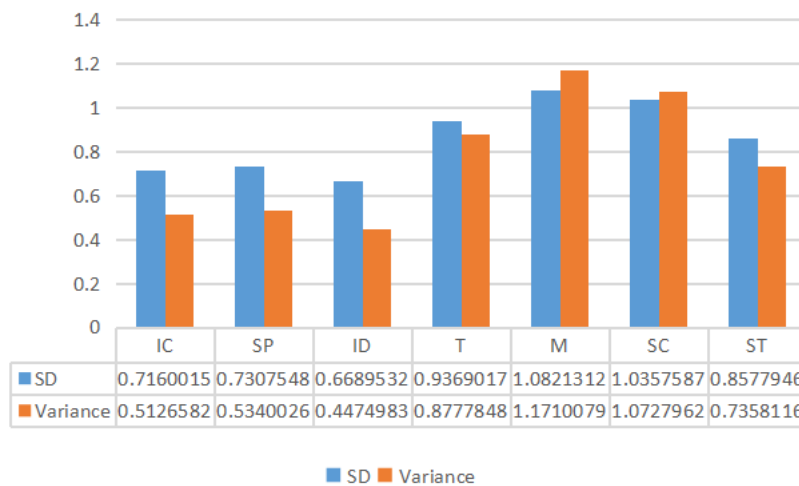


Figure 4: Graphical representation of students' perception of online education (b) (Picture credit: Original).

Table 2: Students' perceptions of online learning.

	M	SC	ST	IC	SP	ID	T
Standard Deviation (SD)	1.082	1.036	0.858	0.716	0.731	0.669	0.937

Table 2: (continued).

Average	3.150	3.278	3.666	3.978	3.846	3.802	2.706
Kurtosis	-0.621	-0.547	0.350	0.997	-0.414	-0.513	-0.342
Variance	1.171	1.073	0.736	0.512	0.534	0.447	0.878
Skewness	0.007	-0.169	-0.398	-0.709	-0.152	-0.063	0.131
Confidence (95%)	0.156	0.149	0.124	0.103	0.105	0.097	0.135
Standard Error (SE)	0.079	0.076	0.063	0.052	0.053	0.049	0.069

4.2. RQ2--The Differences between Students' Perceptions of Online Learning by Gender

4.2.1. Statistical Comparison

Overall, Figure 5 shows that male and female students' perceptions differ in various dimensions, they are still measured on the same scale. Analyzing the minimum values reveals that male students tend to have a more positive perception compared to female students. Specifically, their minimum scores outperform female students in three dimensions, while slightly trailing in one dimension. In the dimensions of Trust (T), Motivation (M), and Self-Efficacy in Communication (SC), both male and female students' minimum perceptual scores are 1 point, indicating strong dissatisfaction. However, in the dimensions of Instructor Characteristics (IC), Social Presence (SP), and Self-Efficacy in Technology (ST), male students' minimum perceptual scores are higher than those of female students. ($IC_{ave-male} = 3.913 < IC_{ave-female} = 4.012$; $SP_{ave-male} = 3.781 < SP_{ave-female} = 3.872$; $ID_{ave-male} = 3.691 < ID_{ave-female} = 3.843$; $M_{ave-male} = 3.130 < M_{ave-female} = 3.151$; $SC_{ave-male} = 3.151 < SC_{ave-female} = 3.361$). In the T and ST dimensions, males perceive more average scores than female students ($T_{ave-male} = 2.710 > T_{ave-female} = 2.701$; $ST_{ave-male} = 3.901 > ST_{ave-female} = 3.682$).

An analysis of the minimum scores indicates that compared to female students, male students typically have a more favorable opinion of online learning. Their minimum scores outperform female students in three specific dimensions while being slightly behind in just one dimension. Specifically, in the areas of Trust (T), Motivation (M), and Self-Efficacy in Communication (SC), both male and female students registered a minimum perceptual score of 1 point, indicating a strong level of dissatisfaction. However, in the dimensions of Instructor Characteristics (IC), Social Presence (SP), and Self-Efficacy in Technology (ST), male students' minimum perceptual scores are higher than those of their female counterparts. ($IC_{min-male} = 2.000 > IC_{min-female} = 1.000$; $SP_{min-male} = 2.000 > SP_{min-female} = 1.871$; $ST_{min-male} = 2.000 > ST_{min-female} = 1.000$). In the Instructional Design (ID) dimension, the minimum perceptual score of males falls below that of female students, suggesting that males are less likely to encounter extremely negative (strongly disagree) experiences compared to female students ($ID_{min-male} = 2.000 < ID_{min-female} = 2.331$).

The mode's comparison analysis shows that the perception disparities between male and female students in the Trust (T), Motivation (M), Self-Efficacy in Communication (SC), and Self-Efficacy in Technology (ST) dimensions are consistent with theoretical theories ($T_{mode-male} = 3.000 > T_{mode-female} = 2.672$; $ST_{mode-male} = 4.000 > ST_{mode-female} = 3.000$). In particular, female students' mode of perception scores are higher than male students' in the M and SC perspectives. However, on the T and ST dimensions, male students' mode of perception scores are greater. Notably, the mode values for both males and females are identical in the Instructor Characteristic (IC) and Social Presence (SP) dimensions. In the ID dimension, males' perception scores have a higher

maximum percentage compared to female students ($ID_{mode-male} = 4.333 > ID_{mode-female} = 4.000$; $M_{mode-male} = 2.000$, disagree; $T_{mode-female} = 2.671$).

More precisely, the majority of male students express dissatisfaction with the motivational aspect, while most female students express dissatisfaction with their degree of faith. This is exemplified by the fact that the discontent-indicating mode of perception scores in the T dimension for female students and the M dimension for male students is lower. The median scores of male and female students are perceived differently, but these differences are minimal in all domains, indicating that the students' assessment levels are similar.

Figure 6 illustrates the comparison between the variance and standard deviation of online learning perception scores for males and females in this study. In comparison to male students, the study reveals that female students had lower variance and standard deviation in every dimension. This suggests that their perceptual evaluations of online learning are more stable and have less variability.

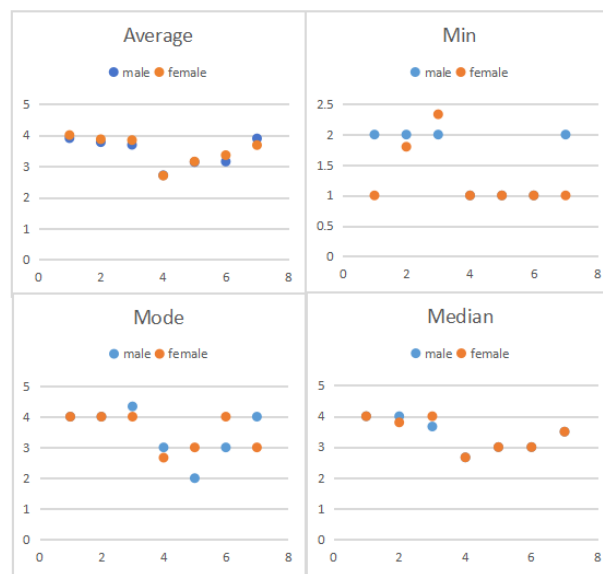


Figure 5: Comparison of students' perceptions of online learning by different gender (a) (Picture credit: Original).

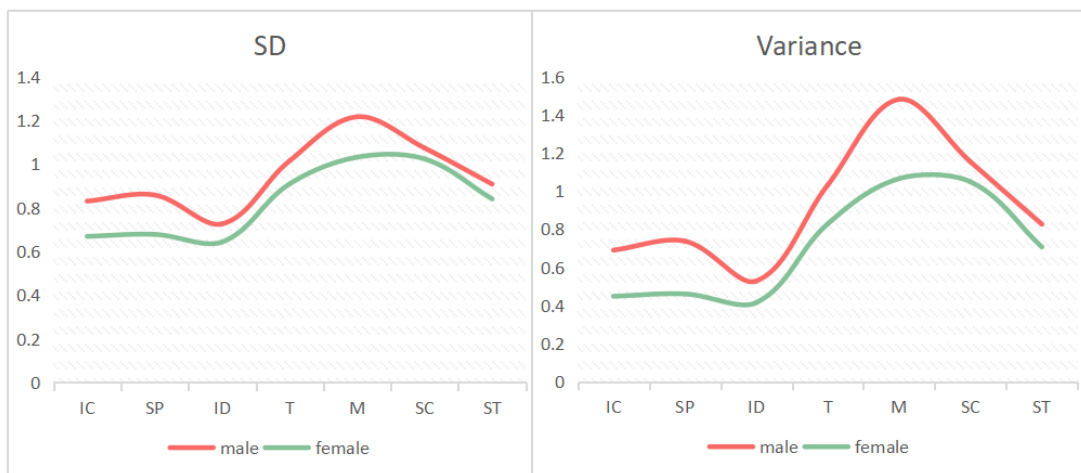


Figure 6: Comparison of students' perceptions of online learning by different gender (b) (Picture credit: Original).

4.2.2. ANOVA Analysis

This study analyzed variance to assess the statistical significance of gender-based fluctuations in students' perception scores for online learning across various dimensions. The comprehensive findings are presented in Table 3.

The analysis revealed four dimensions with significant ($p < 0.1$) gender-based differences: IC, ID, SC, and ST. This indicates that there are statistically notable differences in how male and female students perceive instructor traits, teaching design, self-efficacy for online learning, as well as their utilization of online technology and communication. Remarkably, the reported differences in the ID and SC dimensions are less significant than the perceived differences in the IC and ST dimensions.

Significant gender differences were also revealed by the variance analysis in the ratings of teachers' effectiveness, timeliness, friendliness, and ability to meet students' requirements when it came to their online learning experience. Female students' perceptions were frequently greater than male students in these areas. Additionally, men demonstrated a higher degree of self-efficacy in their use of Internet technologies.

On average, female students had more favorable perceptions in these regards compared to males. Moreover, the analysis tested the significance, revealing that female students, on average, perceived themselves more favorably in these areas than males.

On the contrary, in the areas of SP, T, and M, the differences in perception scores between genders did not reach statistical significance. This finding contrasts with the literature suggesting gender disparities in social existence, trust, and motivation. However, this can be attributed to the shift in online education from a supplementary tool to a crucial means of continued learning during the pandemic. Moreover, the formation of multiple communication channels, such as WeChat groups, during online education has fostered a relatively mature experience in the online learning community. In this context, students of different genders exhibit similar experiences and perceptions regarding social presence, anxiety, and motivation.

The variance analysis's findings showed that the responsibilities of online teachers differed significantly. Furthermore, it demonstrated how gender affected attitudes toward online education throughout the pandemic.

Table 3: ANOVA analysis of students' perception scores about online learning by gender

Factor	F	P-value	significance
M	0.0109	0.9170	
SC	3.3238	0.0694	*
ST	7.5631	0.0064	***
IC	10.7212	0.0012	***
SP	0.6967	0.4046	
ID	4.1768	0.0419	**
T	2.5285	0.1130	

5. Conclusion

The overarching aims of this article are threefold: firstly, to delve into students' perspectives on online education; secondly, to dissect any discrepancies between male and female students. Finally, to elucidate the root causes of such variations. In addressing these objectives, this study employs POSTOL and OLRS as its theoretical underpinnings, examining students' perceptions of online education across seven distinct dimensions: instructor characteristics (IC), technology self-efficacy (ST), motivation (M), communication self-efficacy (SC), social presence (SP), trust (T), and

instructional design (ID). In this case, students' assessments of online information exchange and communication modalities—including interactions with peers, peers' communities, instructors, and course material—are principally covered by IC, SP, ID, and SC. On the other hand, T, M, and ST show how students identify with and comprehend themselves.

The research cohort for this study, which consisted of 189 international students, was examined using quantitative analytic approaches like ANOVA and descriptive statistics. The findings indicate that students' perceptions of instructors, encompassing aspects like friendliness, engagement, efficacy, responsiveness, and ability to meet learning demands, are generally positive. Similarly, their views on social presence, including access to online resources, idea sharing, participation in discussions, utilization of interactive tools, and communication with classmates, are near-satisfactory. Moreover, the design of online courses, encompassing factors like difficulty, group interaction modalities, and clarity of course objectives, also garnered favorable reviews. Additionally, students expressed satisfaction with their self-efficacy in utilizing online technology, communicating online, and their learning motivation. However, on average, students do not believe that online learning offers greater benefits than traditional learning methods. Based on these insights, it can be inferred that in the context of the current epidemic, the fundamental framework for online learning is well-established, with the basic construction of online education, the technical and digital readiness of students and instructors, the integration of online courses into the curriculum system, and the formation of an online communication community all at an acceptable standard. Nevertheless, students still maintain a skepticism that online learning will offer them greater benefits than traditional classrooms, indicating a potential need for a shift in mindset.

A comparison analysis between the opinions of students of different genders regarding online education bolsters our theoretical hypothesis. Male students outperformed female students in certain areas such as instructional design (ID), social presence (SP), instructor characteristics (IC), motivation (M), and communication self-efficacy (SC); male students did better in trust (T) and technical self-efficacy (ST). IC, ID, SC, and SC once more were the four dimensions where statistically significant differences ($p < 0.1$) were found after a more thorough analysis using ANOVA. This suggests a significant difference between the opinions of students of different genders about the qualities of their instructors, the design of the lessons, and their ability to use online resources and communicate effectively.

Nevertheless, there is no statistically significant difference between the genders in motivation (M), trust (T), or social presence (SP). This finding contrasts with previous research, which suggested gender disparities in these areas. Upon reflection, this study attributes this inconsistency to the widespread adoption and acceptance of online education during the pandemic. Students have generally come to view online learning as the norm, resulting in a stronger psychological preparedness—whether positive or negative—towards online education. Furthermore, during online education, diverse communication avenues have emerged among students, including WeChat groups, leading to a relatively refined online community experience for learners. The differences in the genders' perceptions of social presence, anxiety, and peer relationships have decreased in this ecosystem. As a result, a new paradigm that emphasizes the assessment of gender disparities in students' perceptions of online learning has emerged in the "new normal" period.

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