Actually Segregated, Virtually Integrated! The Impact of Virtual Learning on the Sustainable Development of Saudi EFL Students: A Focus on Gender Equality

Ayman Khafaga[1] & Hissah Mohammed Alruwaili[2]

[1] Department of English, College of Science and Humanities, Prince Sattam bin Abdulaziz University, Al-Kharj, Saudi Arabia

[2] Department of English, College of Arts, Jouf University, Sakaka, Saudi Arabia

Correspondence: Ayman Khafaga, Department of English Language, College of Science & Humanities, Al-Kharj, Prince Sattam bin Abdulaziz University, Saudi Arabia. E-mail: a.khafaga@psau.edu.sa

Abstract

This paper is based on the premise that virtual learning is a softener of gender segregation in the Saudi education settings. It explores how virtual learning interconnects with gender equality within the framework of sustainable development. The main objective of the paper is to demonstrate the extent to which virtual learning contributes to softening gender segregation, particularly in a gender-segregated-oriented culture, where gender segregation in education is predominant and virtual learning is a momentous avenue for educational access. The study uses a mixed-method analysis represented by both a quantitative and qualitative analysis. Two instruments are used in data collection: a questionnaire and an interview. The sample of the study consists of 373 female students, who are studying English as a foreign language in four different academic departments in one Saudi university, and 16 male teachers affiliated with the same academic departments in the same Saudi university. Results reveal that virtual learning can bridge gender gaps by providing equal learning opportunities, and, therefore, it can be perceived as a gender-segregation softener. Also, there is a statistically significant correlation between virtual learning and gender equality in terms of female students' academic performance and engagement. This study recommends additional pedagogical applications and uses of virtual learning platforms as a way to reduce gender segregation, particularly in educational settings that are gender-segregated.

Keywords: sustainability, gender-segregation, virtual learning, Saudi EFL context

1. Introduction

In recent years, the government of Saudi Arabia has demonstrated a keen interest in instituting sustainability initiatives within universities, recognizing their vital role in the nation's aspirations for sustainable development (Alotaibi, 2022). This is carried out by recognizing the technical aspects of the sustainable development goals within the framework of its 2030 Vision (Aljaradin et al., 2024). Saudi Arabian universities have embarked on significant digital transformation and e-learning initiatives aimed at fostering sustainable growth. The adoption of digital learning is occurring at an impressive and rapid pace (Khafaga, 2021). Saudi Arabia demonstrates a steadfast dedication to fostering economic diversification and sustainable growth, exemplified by Vision 2030, which reflects the kingdom's resolve towards sustainable development. According to Xiao and Pan (2022), one of the many benefits of digital learning that is particularly significant globally is sustainable development. Importantly, there are numerous benefits to digital learning that greatly support sustainable growth. For instance, students can learn conveniently from home thanks to digital learning, which does away with the necessity for needless transit and challenging travel (Chen et al., 2022).

Education systems in countries like Saudi Arabia, where gender segregation is deeply ingrained, frequently mirror social conventions that keep male and female students apart (Aldossari & Murphy, 2023). New dynamics have been brought about by the emergence of virtual learning, which presents both opportunities for more inclusive education and difficulties with fairness and access (Almdawi et al., 2024). In the context of sustainable development, this study investigates the potential of virtual learning as a means of advancing gender equality. This study endeavors to show how virtual learning contributes effectively to sustainable development in Saudi Arabia in terms of gender equality (sustainable development goal SDG 5). This goal focuses on the different ways by which governments and countries all over the world strive to achieve gender equality for their citizens. Gender segregation in Saudi Arabia has its roots in social and religious ideas, which have an impact on educational systems. Even in online settings, female students frequently have little opportunity to communicate directly with male teachers. This division is also present in online learning, where cultural standards determine whether or not male instructors are appropriate. Asynchronous learning approaches are therefore recommended since they reduce face-to-face interaction and conform to social norms (Wang et al., 2023).

Virtual learning environments have the potential to transcend physical boundaries, offering a platform for both male and female students

to engage in education without the constraints of gender segregation. Much previous research (e.g., Aldegether, 2023; Aldossari & Murphy, 2023; Alhazmi & Nyland, 2015; Alrasheed, 2013) indicates that female students in countries that separate genders, like Saudi Arabia, tend to report more pleasant e-learning experiences than their male counterparts. This might be because people feel more at ease and participate more in online environments that lower conventional boundaries based on gender.

This study, therefore, attempts to explore how virtual learning interconnects with gender equality within the framework of sustainable development. The main purpose of the paper is to demonstrate how virtual learning contributes to softening gender segregation, particularly in a gender-segregated-oriented culture, where gender segregation in education is predominant, and virtual learning is a momentous avenue for educational access. The paper's main hypothesis is that virtual learning is a softener of gender segregation in the Saudi education settings. The study is important because its primary goals align with the Saudi 2030 Vision, which emphasizes the link between advanced technologies in learning and sustainable development (objective No. 5 specifies gender equality in the context of this paper). This is significant for two reasons: first, this study highlights how virtual learning contributes to gender equality in Saudi Arabia, specifically by softening gender segregation in the education process; second, it demonstrates how much Saudi Arabia's 2030 vision acknowledges the technological component of the SDGs. Saudi Arabia has undoubtedly implemented a variety of policies and initiatives to assist in achieving not only the SDG objective pertaining to gender equality but also the 17 Sustainable Development Goals.

1.1 Research Objectives

This study tries to achieve the following objectives:

1. To explore how virtual learning softens gender segregation in the Saudi education context.

2. To demonstrate how virtual learning offers better learning opportunities for Saudi female university students.

3. To shed light on the significant correlation between virtual learning and sustainable development in terms of gender equality.

1.2 Research Questions

This paper raises one overarching research question:

1. How does virtual learning contribute to softening gender segregation in the Saudi education context?

This general research question comprises further subsidiary research questions as follows:

a) Does virtual learning offer better learning opportunities for Saudi female students?

b) Is virtual learning a bolster for sustainable development in terms of gender equality?

c) Does virtual learning enhance Saudi female students' academic performance and engagement?

The remainder of this study is structured as follows: Section 2 provides the theoretical background and the literature review of the study, in which a detailed discussion on virtual learning, the educational context in Saudi Arabia, gender and education, and sustainability and education is presented. Section 3 is the methodology of the study, wherein the data collection, description, design of the study, participants, and instruments of the study are offered. Section 4 demonstrates the results of the study. Section 5 is the discussion of the results obtained from the analysis of the collected data. Section 6 is the conclusion of the study. Section 7 presents the limitations and the pedagogical implications of the study and also offers some recommendations for future research.

2. Theoretical Preliminaries and Literature Review

2.1 Education and Sustainable Development in Saudi Arabia

The term "sustainable education" refers to the process of learning that respects cultural variety and gives students the tools they need to make wise decisions and take on responsibility for the environment, the economy, and a peaceful community for future generations (Taimur & Sattar, 2020). Furthermore, educational sustainability pledges to educate the next generation about global issues and self-improvement (Bekteshi & Xhaferi, 2020). Additionally, it is recognized that the principles of sustainable development should be taught in a range of disciplines and incorporated into the existing curriculum rather than being a new, exclusive topic (Xiao & Pan, 2022). Accordingly, sustainable development education is incorporated into a number of topic areas, including instruction, in accordance with this concept. Furthermore, it is clear that online education helps to reduce the negative ecological effects of production and transportation processes. The resources required for the old educational system, such as textbooks, desks, energy, and buildings, are significantly reduced by online learning. As a result, valuable natural resources are conserved and less garbage is generated. Additionally, both students and educational institutions save time and money when they use digital learning.

To clarify, a well-known fact that UNESCO (2005a&b) highlights is that education is a crucial element of sustainable development. High-quality education is one of the fundamental goals of sustainable development. As a result, education becomes an essential facilitator and support system for sustainable development, which has been recognized globally (Zhao et al., 2022; An et al., 2022). Tenacity, endurance, and sustenance are often described as sustainability. It may also entail preserving environments, cultures, or infrastructure. Often, it is related to development, such as the concept of sustainable development. Notwithstanding these diverse interpretations, it is generally accepted that sustainability projects incorporate social, economic, and ecological considerations. Additionally, these three elements are linked to and rely upon one another (Zhao et al., 2022).

In the Saudi education context, one of the sustainable development objectives is 'gender equality,' which indicates that both genders,

males and females, have equal opportunities in all aspects of life, including the right of both genders to have the same access to educational opportunities. All people can benefit from this kind of gender equality in education, even during catastrophes, thanks to virtual learning (Petkute, 2012; Silva et al., 2021; Vilmala et al., 2022). With the help of virtual classrooms offered by digital platforms, students (males and females) can dedicate themselves to the learning process and all of its various activities at any time or location. The possibility of both genders joining the same virtual classes and the flexibility to promote diverse learning structures throughout the virtual learning process might be considered a response to the question of how virtual learning promotes sustainable development in terms of gender equality, particularly by contributing to softening gender segregation in an educational setting.

2.2 Gender Segregation in the Saudi Education Context

In many regions of the world, gender segregation in education is still common. For example, Saudi Arabian schools are frequently gender-segregated, which might hinder male and female students' ability to socialize and work together. Such division could impede the advancement of gender equality and perpetuate traditional gender norms (Aldossari & Murphy, 2023). According to Aldegether (2023), Saudi Arabia's interpretation of Islamic principles and adherence to traditional cultural standards are the main factors influencing its commitment to gender segregation in schools. Separate institutions for boys and girls were established when formal education was introduced in Saudi Arabia in the middle of the 20th century. At first, there were few educational opportunities for girls, but as society recognized the value of women's education, the number of schools catering to female students grew. For Allily (2011), gender segregation is still common in Saudi Arabia today at all educational levels. For example, in primary and secondary education, male and female students attend distinct schools that are completely segregated by gender. The teaching staff is also segregated, with female instructors teaching girls and male teachers teaching boys. Despite being standardized, the curriculum frequently reflects gendered ideas, especially in social science and family-related courses. Likewise, in higher education (the context of the current study), male and female students are housed on different campuses or in different facilities at universities. The overall organization is still gender-segregated, despite the fact that several universities have implemented coeducational programs in particular subjects. Significantly, several factors contribute to the continued existence of gender segregation in Saudi education, including religious interpretations of Islamic teachings, cultural traditions, and governmental policies (Aldegether, 2023). Consequently, understanding how society, culture, organizations, and individual attitudes of gender inclusion interact is made possible by the socio-institutional context of Saudi Arabia. Research that has been done in Saudi Arabia at the macro level emphasizes how social norms, cultural traditions, and social rules have a big impact on women's status and gender equality (Alrasheed, 2013).

2.3 Virtual Learning in the Context of a Gender-Segregated Culture

The Saudi education system is characterized by gender segregation that dominates all education stages from the primary stage to the university one and is also evident in both private and public (governmental) institutions (Allily, 2011; Alhazmi & Nyland, 2015). This gender segregation system in education is entirely a part of Saudi Arabia's cultural, social, and religious beliefs (Baki, 2004). In the Saudi educational system, male and female students are kept apart to prevent gender mixing. Even in the virtual world, gender mixing is a delicate and important topic (Alhazmi & Nyland, 2015; Baki, 2004). Female students typically get separate instruction without direct interaction with any males, including their male lecturers or tutors, and are kept apart from male students throughout the duration of their study (Alhazmi & Nyland, 2015). Furthermore, when a male tutor was present, they would communicate via a virtual environment or another medium. Studies conducted on Saudis (Almunajjed, 1997) revealed that cultural and religious considerations created a number of obstacles to higher education for Saudi women, who formerly had fewer university spots than men. Nonetheless, women's empowerment and equal opportunity, including access to education, are the goals of Saudi Vision 2030 (Aldegether, 2023).

Previous studies conducted in gender-segregated societies, like Saudi Arabia, have demonstrated that virtual learning increases women's access to higher education (Alhazmi & Nyland, 2013, 2015; Achoui, 2006; Khafaga & Alghawli, 2021). Nevertheless, according to Alhazmi and Nyland (2015, p. 646), "social and religious beliefs, particularly male authority, segregation, and family honor, are the main factors that limit access of Saudi women to e-learning." Therefore, when creating virtual learning systems, it is essential to take this culture and these values into account (Alhazmi & Nyland, 2015; Elci, 2005). Since it is prohibited to communicate with unrelated males, the gender of lecturers is quite important. The women's family disapproves of any classes taught by male lecturers (Allily, 2011). Due to these factors, asynchronous e-learning is preferred by women and their families, which restricts face-to-face engagement with male instructors and/or students (Alhareth, 2014).

Further, there is still a dearth of research on how gender affects students' experiences throughout COVID-19. There is not much published research that looks at how male and female students perceive or experience online learning differently. For instance, it was discovered that female medical students had better e-learning experiences than male students (Anwar et al., 2021), whereas another study found no discernible gender-based differences in students' virtual learning experiences during COVID-19 (Thapa et al., 2021). According to current research, male and female students' virtual learning experiences should differ significantly, particularly in countries where gender roles are segregated and women were frequently exposed to technology-based learning prior to COVID-19 (Alhazmi & Nyland, 2015). Since female students are more likely than male students to be familiar with virtual learning due to the lack of traditional face-to-face instruction in this gender-segregated culture, these inequalities in attitudes and virtual learning experiences are presumed (Baki, 2004).

3. Methodology

3.1 Research Method and Instruments

The study uses both quantitative and qualitative methods of analysis that are represented in the employment of two analytical instruments. The first is the questionnaire, and the second instrument is the interview. As a result, the study is a quantitative-qualitative analysis of the data gathered for the intended analytical goals. Both the questionnaire and the interview were created and distributed to participants electronically in order to collect data. Potential participants had to complete an informed permission form before they could access the survey, saying that they were willing to engage in the study and that they agreed to the use of their data for research. At the end of the first semester of 2024, the survey was created utilizing the Google Forms platform and disseminated to participants through WhatsApp groups, and the interviews were conducted through personal phone calls with the teachers. After taking permission from respondent teachers, these phone calls were recorded and then coded for analytical purposes. The questionnaire's statements focused on one main goal: determining how virtual learning contributes to sustainable development in terms of softening gender segregation in the Saudi educational context. The interview questions also center on how much virtual learning serves as a softener for gender segregation in Saudi Arabia, which, in turn, functions to support sustainable development. While the students' questionnaire used a 5-point Likert scale (strongly disagree, disagree, neutral, strongly agree, agree) to rate agreement, disagreement, and/or neutrality in terms of the questionnaire's statements, the teachers were interviewed using a 3-point Likert scale (positive, neutral, and negative) to rate their attitudes. By using a Likert scale, negative or reverse statements were intentionally included to help identify responders who may not be paying careful attention to the questions or who are responding consistently. All statements of the questionnaire and the questions of the interview have been translated into Arabic (the mother tongue of all respondent students and teachers) for the participants who are not specialized in English. The main focus of the students' questionnaire and the teachers' interview is to show the extent to which virtual learning contributes to gender equality by softening gender segregation in the Saudi education context.

3.2 Sampling and Participants

The total number of participants in this study is 497, and they are of two types: the first is the female students at Prince Sattam bin Abdulaziz University (PSAU) in Saudi Arabia. The sample of this type consists of 373 (n=373) students. These female students are distributed to four academic departments: the English department (n=84), the Business Administration department (n=112), the Computer Science department (n=96), and the Islamic Studies department (n=81). These female students range in age from 16 to 21 years old, and all of them are Saudi. To ensure that they are representative of the study sample, they are chosen randomly. The second type of participants is the teachers. They are 16 (n=16) teachers from different nationalities, whose ages range from 36 to 57, and all of them are males. They teach virtual courses at PSAU and are distributed to four departments: the English department (n=4), the Business Administration department (n=5), the Computer Science department (n=4), and the Islamic Studies department (n=3). The reason why female teachers are excluded is that the core concern of the current study is to address how virtual learning contributes to softening gender segregation in the Saudi EFL context, and this can be achieved by confining the sample of teachers to males and the sample of students to females. This is because virtual learning is obligatory in Saudi universities only in virtual classes whose students are females and whose teachers are males. Face-to-face instruction from male teachers to female classes is still not allowed in Saudi Arabia.

3.3 Research Design

This study uses a mixed-method approach (Creswell & Clark, 2011), which is based on the mixed-methods grounded theory (Guetterman et al., 2019). This is demonstrated by the inclusion of aspects of both quantitative and qualitative processes. The potential for mixing quantitative and qualitative data in the study to yield solid and valid results justifies the mixed-methods approach. Additionally, the quantitative-qualitative methodological integration enables a comprehensive understanding of how teachers and students perceive virtual learning in relation to classroom participation and in-person instruction. The design of this empirical study consists of an interview with teachers and a four-part questionnaire for students. Since the researchers could keep an eye on and observe the study participants, the decision to select only one Saudi institution to represent the sampled population was chosen in order to produce verifiable and believable results, despite the fact that this is one of the study's drawbacks.

The students' questionnaire consists of 30 statements presenting four variables: (1) accessibility and participation, in which the focus is equal access and engagement of both genders in virtual learning; (2) perception and attitude, in which the focus is on shifts in cultural and/or personal attitudes regarding gender roles in education; (3) institutional and instructor practices, in which the focus is on institutional efforts and instructor behaviors in supporting gender integration; and (4) social impact and future outlook, in which the focus is on broader societal and educational outcomes of reduced gender segregation. Although the questionnaire is designed to assess participants' opinions regarding the effectiveness of virtual learning in promoting and maintaining sustainable development in terms of gender equality, the interview aims to explore the attitudes, subjective experiences, and emotional reactions of teachers regarding the ways in which virtual learning softens gender segregation in the Saudi educational context. Therefore, the goal of the interview is to add qualitative information to the quantitative data from the questionnaires. Participating teachers were interviewed one by one, and respondents' privacy and the confidentiality of the information they provided were ensured. The survey was anonymous and voluntary and safeguarded the privacy of the data. All personally identifying information about respondents was removed from the results that were made public in order to maintain anonymity. Before conducting the questionnaire and the interviews, all participants are asked in written form to decide whether or not they agree to participate in the study. Only the participants who agree to participate in the study are involved; others are excluded.

Also, all participants have been fully informed that their anonymity is assured, the reason why the research is being conducted, how their data will be utilized, and if there are any risks to them of participating.

3.4 Validity and Reliability

The accuracy of the questionnaire and the interview was validated by three university English professors who specialize in teaching English as a foreign language. They looked over and verified the accuracy of the interview questions and questionnaire items, as well as their phrasing and structure, objectivity, application, relevance, and clarity. They recommended a number of changes and additions, all of which were fully included in the instruments employed. The internal consistency of the questionnaire questions was measured using Cronbach's alpha equation, a widely used indicator of the internal consistency and reliability of opinion surveys (Kane, 2013). The students' questionnaire had reliability ratings of 0.84. The researcher employed internal consistency to prove stability using a questionnaire sample of 20 female students. Statistics show that items are more consistent with each other when the Cronbach's alpha value is higher (Tavakol & Dennick, 2011). Consequently, a very high level of internal consistency was achieved, indicating the appropriate reliability of the surveys. The Cronbach's alpha coefficient for data analysis was calculated using the Statistical Package for Social Science (SPSS, version 25), in addition to survey analyses.

3.5 Research Procedures

The stages of the analytical processes used in this study include data preparation, questionnaire and interview designation, distribution, data collection, results identification, results discussion, and linguistic and pedagogical implications. The study, therefore, is based on two main analytical phases: the quantitative analysis, in which survey data was analyzed using descriptive and inferential statistical techniques such as questionnaires to demonstrate responses from participants; and the qualitative analysis, wherein the focus was on finding recurrent themes and patterns in the teachers' interviews, and thematic analysis was used, with an emphasis on experiences pertaining to the role of virtual learning as a bolster for sustainable development, particularly in terms of gender equality. The main analytical focus of this study, thus, is to explore how virtual learning supports gender equality and sustainable development in Saudi Arabian educational institutions, specifically with regard to the extent to which virtual learning contributes effectively to softening gender segregation in the Saudi education context through the various analytical techniques used.

4. Results

4.1 Results Pertaining to the Demographic Data of Participants

This part presents the results related to the demographic data of the participants. Consider Table 1.

Table 1. Demographic characteristics of the respondents (n=389)

Participants	Department	Number	Gender	Nationality	Use virtual learning	Total
Students	English	84	Female	Saudi	Yes	373
	Business Administration	112	Female	Saudi	Yes	
	Computer Sciences	96	Female	Saudi	Yes	
	Islamic Studies	81	Female	Saudi	Yes	
Teachers	English	4	Male	1 Egyptian 1 Saudi 1 Algerian 1 Moroccan	Yes	16
	Business Administration	5	Male	3 Sudanese 1 Egyptian 1 Syrian	Yes	
	Computer Sciences	4	Male	1 Tunisian 1 Yemeni 1 Sudanese 1Egyptian	Yes	
	Islamic Studies	3	Male	Saudi	Yes	389

Table 1 shows that the two types of participants (i.e., students and teachers) are affiliated with four departments at PSAU in Saudi Arabia. All respondent students are Saudi females who undergo a process of learning that is totally based on virtual learning. All respondent teachers, on the other hand, are males who have different nationalities with different cultural backgrounds. Selecting participants from different academic departments and different nationalities serves to represent credible and general results.

4.2 Results Pertaining to Respondent Students' Questionnaire: Variable 1. Accessibility and Participation

This part presents the perception of respondent students in terms of the first variable, namely accessibility and participation. The main focus of this variable is to test students' attitudes concerning the equal access and engagement of both genders in virtual learning classes.

Table 2. Respondent students' perception of virtual learning as a gender-segregation softener in terms of accessibility and participation (n=373)

	Statement	Responsive attitude										M	SD
		SD		D		N		A		SA			
		N	%	N	%	N	%	N	%	N	%		
1	Virtual learning has increased my access to courses previously unavailable due to gender-based restrictions.	3	0.81	12	3.21	9	2.41	214	57.37	135	36.19	4.25	0.72
2	Online classes provide equal participation opportunities for male and female students.	3	0.81	7	1.87	6	1.60	159	42.62	198	53.08	4.45	0.70
3	I feel more comfortable participating in discussions during virtual classes than in physical classrooms.	4	1.07	10	2.68	3	0.81	217	58.18	139	37.26	4.28	0.71
4	Virtual platforms allow interaction with instructors regardless of gender.	0	0.00	0	0.00	3	0.81	209	56.03	161	43.16	4.42	0.51
5	Female students are not encouraged to contribute equally during online sessions.	152	40.75	203	54.42	2	0.53	12	3.21	4	1.07	1.69	0.74
6	I feel ashamed when I participate in virtual classes in the presence of the opposite gender.	112	30.02	167	44.77	23	6.16	31	8.31	40	10.72	2.25	1.26
7	My institution promotes gender-inclusive practices in virtual learning.	14	3.75	11	2.94	34	9.11	186	49.86	128	34.31	4.08	0.94
8	Gender does not affect my ability to access course materials in online learning platforms.	10	2.68	5	1.34	3	0.81	234	62.73	121	32.43	4.21	0.76

Note: SD (Strongly Disagree), D (Disagree), N (Neutral), A (Agree), SA (Strongly Agree), M (mean), SD (Standard Deviation)

As indicated in Table 2, the majority of respondent students expressed positive attitudes concerning the equal access and engagement in virtual learning classes. This positive attitude is clearly shown in all statements of this variable. The table clarifies that 57.37% and 36.19% (M= 4.25) of respondent students expressed their agreement that their access to virtual classes has been improved by virtual learning, which indicates that they can join and access courses previously unavailable due to gender-based restrictions. Respondent students also agree (42.62%, 53.08%; M= 4.45) that they have been provided equal participation opportunities when they are taught using online platforms. Such participation opportunities and access availability are clearly mirrored in the respondents' agreement (58.18%, 37.26%; M= 4.28) that they feel more comfortable participating in discussions during virtual classes than in physical classrooms. In the negative (reverse) statements (5 and 6), it has been shown how respondents were very careful in responding to the questionnaire, as they expressed their disagreement with the idea that they (female students) are not encouraged to contribute equally during online sessions (40.75%, 54.42%; M= 0.74) and that they feel ashamed when they participate in virtual classes in the presence of the opposite gender (30.02%, 44.77%; M= 1.26). Respondents also agree (49.86%, 34.31%; M= 4.08) that the university where they study promotes gender-inclusive practices in virtual learning and that gender does not affect their ability to access course materials in online learning platforms (62.73%, 32.43%; M= 4.21).

4.3 Results Pertaining to Respondent Students' Questionnaire: Variable 2. Perception and Attitude

This part demonstrates the perception of respondent students in terms of the second variable, namely perception and attitude. The main focus of this variable is to test students' attitudes regarding the shifts in cultural and/or personal attitudes regarding gender roles in education.

Table 3. Respondent students' perception of virtual learning as gender-segregation softener in terms of perception and attitude (n= 373)

	Statement	Responsive attitude										M	SD
		SD		D		N		A		SA			
		N	%	N	%	N	%	N	%	N	%		
1	Virtual learning has changed my perception of gender roles in academic settings.	5	1.34	13	3.48	4	1.07	187	50.13	164	43.97	4.32	0.78
2	I believe virtual learning helps challenge traditional gender norms in Saudi education.	11	2.94	14	3.75	21	5.63	137	36.72	190	50.9	4.29	0.92
3	I am more open to collaborating with the opposite gender in virtual classes.	13	3.48	19	5.09	34	9.11	171	45.84	136	36.46	4.07	0.98
4	Exposure to diverse perspectives in online discussions has reduced my gender bias.	11	2.94	14	3.75	23	6.16	192	51.47	167	44.77	4.20	0.90
5	I see virtual classrooms as safer environments for gender-mixed interactions.	3	0.80	8	2.14	42	11.26	139	37.26	181	48.52	4.31	0.81
6	Online learning is helping normalize academic equality between genders.	7	1.87	11	2.94	41	10.99	198	53.08	116	31.09	4.09	0.84
7	I have more negative attitudes toward mixed-gender academic collaboration since using virtual platforms.	156	41.82	163	43.69	32	8.57	12	3.21	10	2.68	1.81	0.92

Table 3 demonstrates that respondent students have positive attitudes apropos the change in cultural and personal attitudes regarding gender roles in education. They expressed their agreement that virtual learning has changed their perception of gender roles in academic settings (50.13%, 43.97%; M= 4.32), that they believe virtual learning helps challenge traditional gender norms in Saudi education (36.72%, 50.9%; M= 4.29), that they are more open to collaborating with the opposite gender in virtual classes (45.84%, 36.46%; M= 4.07), that the exposure to diverse perspectives in online discussions has reduced their gender bias (51.47%, 44.77%; M= 4.20), and that they perceive online learning as helping normalize academic equality between genders (53.08%, 31.09%; M= 4.09). In terms of the reverse statement No. 7, respondent students demonstrated their disagreement with the idea that they have more negative attitudes toward mixed-gender academic collaboration since using virtual platforms (41.82%, 43.69%; M= 1.81).

4.4 Results Pertaining to Respondent Students' Questionnaire: Variable 3. Institutional and Instructor Practices

This part displays the perception of respondent students in terms of the third variable, i.e., institutional and instructor practices. The focus of this variable is to test students' attitudes in terms of the institutional efforts and instructor behaviors in supporting gender integration.

Table 4. Respondent students' perception of virtual learning as a gender segregation softener in terms of institutional and instructor practices (n= 373)

	Statement	Responsive attitude										M	SD
		SD		D		N		A		SA			
		N	%	N	%	N	%	N	%	N	%		
1	My instructors treat male and female students equally in virtual settings.	3	0.80	7	1.87	3	0.80	224	60.05	136	36.46	4.29	0.66
2	The institution uses gender-neutral language and policies in online courses.	2	0.53	3	0.80	0	0.00	240	64.34	128	34.31	4.31	0.57
3	Course content in virtual learning platforms is inclusive of both genders.	2	0.53	3	0.80	11	2.94	198	53.08	159	42.62	4.36	0.64
4	Gender segregation is less enforced in virtual classes than in physical classrooms.	1	0.26	4	1.07	9	2.41	219	58.71	140	37.53	4.32	0.60
5	Teachers promote interaction among all students regardless of gender.	2	0.53	1	0.26	7	1.87	251	67.29	112	30.02	4.26	0.56
6	The administration encourages gender-mixed academic projects in virtual formats.	18	4.82	24	6.43	16	4.28	167	44.77	148	39.67	4.08	1.06
7	Virtual learning has led to more equitable teacher-student interactions across genders.	2	0.53	3	0.80	4	1.07	243	65.14	121	32.43	4.28	0.58

Table 4 clarifies that respondent students have positively perceived virtual learning as a gender-segregation softener in terms of institutional and instructor practices. This positive attitude is clearly shown in their response to the above part of the questionnaire. To clarify, respondent students expressed their agreement that their teachers treat male and female students equally in virtual settings (60.05%, 36.46%; M= 4.29) and that they promote interaction among all students regardless of gender (67.29%, 30.02%; M= 4.26), that the university uses gender-neutral language and policies in online courses (64.34%, 34.31%; M= 4.29), and that it encourages gender-mixed academic projects in virtual formats (44.77%, 39.67%; M= 4.08). Respondent students further expressed their agreement that the content of courses in virtual learning platforms is inclusive of both genders (53.08%, 42.62%; M= 4.36) and that gender segregation is less enforced in virtual classes than in physical classrooms (58.71%, 37.53%; M= 4.32). Also, the majority of respondents (65.14%, 32.43; M= 4.28) have a positive attitude that virtual learning has led to more equitable teacher-student interactions across genders.

4.5 Results Pertaining to Respondent Students' Questionnaire: Variable 4. Social Impact and Future Outlook

This part shows the perception of respondent students in terms of the fourth variable, namely social impact and future outlook. The focus of this variable is to test students' attitudes with regard to the broader societal and educational outcomes of reduced gender segregation.

Table 5. Respondent students' perception of virtual learning as a gender segregation softener in terms of social impact and future outlook (n= 373)

	Statement	Responsive attitude										M	SD
		SD		D		N		A		SA			
		N	%	N	%	N	%	N	%	N	%		
1	Virtual learning could serve as a model for reducing gender segregation in other sectors.	3	0.80	4	1.07	2	0.53	265	71.04	99	26.54	4.21	0.58
2	I believe virtual education can help promote gender equality in Saudi Arabia.	4	1.07	3	0.80	16	4.28	283	75.87	67	17.96	4.09	0.59
3	Interacting virtually with the opposite gender has improved my communication skills.	3	0.80	12	3.21	7	1.87	236	63.27	115	30.83	4.20	0.70
4	Online learning has made me more accepting of gender diversity in academic environments.	6	1.60	11	2.94	4	1.07	279	74.79	73	19.57	4.08	0.68
5	I expect future educational policies will support more gender-integrated learning models.	3	0.80	2	0.53	12	3.21	295	79.08	61	16.35	4.10	0.53
6	My family's perception of mixed-gender education has	9	2.41	17	4.55	21	5.63	283	75.87	43	11.52	3.90	0.75

	become more positive due to online learning.										
7	Virtual learning contributes to bridging gender gaps in academic achievement.	7	1.87	5	1.34	18	4.82	272	72.92	71	19.03	4.06	0.68
8	I would support further integration of genders in education through online platforms.	3	0.80	6	1.60	29	7.77	197	52.81	138	36.99	4.24	0.73

Table 5 displays the attitudes of respondent students concerning the social impact and future outlook of virtual learning and how it contributes to decreasing gender segregation. As indicated in Table 5, the majority of respondent students expressed nearly unanimous agreement that virtual learning could serve as a model for reducing gender segregation in other sectors (71.04%, 26.54%; M= 4.21), that the interaction with the opposite gender virtually has improved their communication skills (63.27%, 30.83%; M= 4.09), and that online learning has made them more accepting of gender diversity in academic environments (74.79%, 19.57%; M= 4.08). This agreement has resulted also in their positive attitude that virtual education can help promote gender equality in Saudi Arabia (75.87%, 17.96%; M= 4.09). Furthermore, respondent students agree (79.08%, 16.35%; M= 4.10) gender-integrated learning models will be supported by educational policies in the future. They also agree that their families' perception of gender-mixed education has become more positive due to online learning (75.87%, 11.52%; M= 3.90). Respondent students concluded their responses by positively perceiving virtual learning to contribute to bridging gender gaps in academic achievement (72.92%, 19.03%; M= 4.06), and that they would support further integration of genders in education through online platforms (52.81%, 36.99%; M= 4.24).

4.6 Results Pertaining to Respondent Teachers' Interviews

This part clarifies the perception of respondent teachers concerning the contribution of virtual learning to gender equality and its effective role in softening gender segregation in the Saudi educational context.

Table 6. Teachers' perception of virtual learning as a gender segregation softener (n= 16)

	Interview question	Responsive attitude							
		Positive		Neutral		Negative		M	SD
		No.	%	No.	%	No	%		
1	In academic environments, how has virtual learning changed the academic performance of female students?	11	68.75	1	6.25	4	25.00	0.44	0.86
2	Do you think that virtual learning facilitates the normalization of mixed-gender collaboration in Saudi education?	11	68.75	0	0.00	5	31.25	0.38	0.93
3	What challenges, if any, have you faced while engaging in gender-integrated virtual learning environments?	13	81.25	1	6.25	2	12.5	0.69	0.68
4	Do you think that virtual learning softens gender segregation in the Saudi education context?	10	62.5	1	6.25	5	31.25	0.31	0.92
5	Could you give any particular examples of how opportunities that would have been limited in a typical classroom with gender segregation were made possible via virtual learning?	11	68.75	2	12.5	3	18.75	0.50	0.79
6	Do you think that both male and female students can learn in a more secure or equitable atmosphere using virtual learning platforms?	15	93.75	0	0.00	1	6.25	0.88	0.48
7	Have you noticed any changes in your female students' attitudes or behaviors regarding gender interaction as a result of virtual learning?	12	75.00	1	6.25	3	18.75	0.56	0.79

Table 6 reveals a positive attitudinal perception of respondent teachers in terms of the role of virtual learning as a softener of gender segregation in the Saudi educational context. In response to the first question in the interview, the majority of teachers (68.75%; M= 0.44) have a positive attitude that virtual learning has effectively contributed to the female students' academic performance. Teachers agree that female students' performance and engagement have increased in terms of learning self-efficacy, attendance, and willingness to communicate. They also maintained that female students' learning anxiety has been decreased during virtual classes, as they start to participate in classroom activities and practice the various linguistic and communicative skills more effectively. Respondent teachers also agree (68.75%; M= 0.38) that the use and application of virtual learning environments serve to facilitate the normalization of mixed-gender collaboration in Saudi education. The same positive attitude has also been expressed by teachers when they are asked about challenges they face during virtual classes. Respondent teachers (81.25%; M= 0.69) emphasized that they faced very few obstacles at first, as female students took a short period of time to actively participate in classroom activities, particularly in the presence of males. 62.5% (M= 0.31) of respondent teachers agree that virtual learning functions to soften gender segregation in the Saudi education context. When asked to give examples of how opportunities that would have been limited in a typical classroom with gender segregation were made possible via virtual learning, the majority of respondent teachers (68.75%; M= 0.50) stated that there are so many academic activities that have been motivated through virtual learning, such as the participation of the two genders in preparing class presentations and participation in the graduation projects. Teachers also acknowledged a positive shift in the female students' attitudes concerning the classroom communication between them and their male teachers. A nearly unanimous number of respondent teachers (93.75%; M= 0.88) expressed their agreement that both male and female students can learn in a more secure or equitable atmosphere using virtual learning platforms, and 75.00% (M= 0.56) of them also confirmed that they noticed some changes in their female students' attitudes regarding gender interaction as a result of virtual learning, among which is the female students' willingness to communicate during virtual classes.

5. Discussion

The above analysis and results show that virtual learning in the Saudi educational context has demonstrated potential in softening the strict frameworks of gender segregation in the classroom. These platforms give female students the chance to participate in educational experiences that go beyond conventional gender boundaries by offering accessible, inclusive, and flexible learning settings. The results of this study imply that virtual classrooms can be a game-changing instrument for advancing gender parity in education. Virtual learning may empower female students and help accomplish sustainable development goals by offering a platform that cuts across geographical and cultural barriers. These results come in conformity with many previous studies (e.g., Alhazmi & Nyland, 2013, 2015; Achoui, 2006; Alrawashdeh et al., 2021; Baki, 2004; Thapa et al., 2021) that acknowledged the effect of virtual learning in fostering gender equality in education. The results of the current study highlighted the effective contribution of virtual learning as a gender-segregation softener. This implies that digital technologies are especially advantageous to female students, improving their skills and performance in virtual learning environments. Results have also demonstrated that virtual learning reduces gender segregation, as it involves promoting a more inclusive and equitable educational environment by altering attitudes and views, changing institutional and teacher practices, and producing significant social effects. Saudi Arabia's approach to gender relations is still influenced by cultural and religious sensitivities, but virtual learning offers a practical and culturally sensitive alternative to achieve more gender parity in education. Virtual learning may not only lessen gender segregation but also help overcome it completely for the sake of social and national advancement as technology advances and cultural views change.

There are several theoretical and practical ramifications of the aforementioned findings. In terms of theoretical ramifications, this study added to the overall corpus of scholarly literature review about the comprehension and development of virtual learning experiences for various gender types. The study clarified that virtual learning has a significant impact on gender equality and contributes to softening gender segregation in the Saudi educational context in terms of four variables, including accessibility and participation, perception and attitude, institutional and instructor practices, and social impact and future outlook. It is analytically revealed in this study that virtual learning in the Saudi educational context increases the accessibility and participation of female students. The results have shown that virtual learning provides equal participation opportunities for female students, enhances their class participation and academic performance, and increases their willingness to communicate. These results correlate with a number of studies conducted in gender-segregated contexts, such as Alyahya et al. (2022), Liu et al. (2022), and Chaisiri (2023) who emphasized that virtual learning can lessen the limitations associated with single-sex education, as it provides female students more access to higher education, particularly in asynchronous settings that restrict face-to-face interaction between men and women, which is consistent with cultural norms that support segregation.

The obtained results also show that virtual learning has significant long-term social ramifications for gender segregation. Virtual learning helps women get ready for mixed-gender workplaces by giving them access to high-quality education and allowing them to engage with peers and teachers of both genders. In line with Saudi Vision 2030, which aims to modernize the nation's socioeconomic environment and expand female workforce participation, this improves women's employability and engagement in the national workforce. This correlates with Safdar et al. (2020), who stated that virtual learning may eventually be used as a paradigm for a shift to more inclusive teaching methods. Although it might not completely eliminate gender segregation right away, it serves as a bridge, progressively changing social norms and increasing acceptance of coeducation. Greater gender integration in traditional classroom settings may be made easier by the growing familiarity with gender-integrated online learning. Regarding gender roles in education, the results of this study reconcile with Zheng et al.'s (2021) argument that virtual learning has greatly changed both individual attitudes and social conceptions. Gender segregation has also been loosened by changes in instructor and institutional behaviors brought about by virtual learning. Saudi Arabian educational institutions are gradually implementing digital tools that enable both genders to have equal access to high-quality instruction and learning resources. These modifications promote an approach to teaching and learning that is less gender prejudiced.

Furthermore, the analysis of the responses concerning the first variable in this study (i.e., accessibility and participation) demonstrates a strong belief that gender segregation is weakened in virtual learning in terms of accessibility and participation. Positive statements like inclusive interaction, comfort, instructor accessibility, and institutional support are highly agreed with. These results point to a bright future for technology's contribution to gender equality in education. The general consensus suggests that virtual education is effectively reducing the constraints that were previously imposed by social and physical gender segregation, even though there are still some small discomforts. Virtual learning has become a potent instrument for social change in addition to being a practical solution to practical problems. It is essential for lowering gender-based obstacles, increasing comfort and involvement, and advancing fair access to education in Saudi Arabia.

Still, the results suggest that online settings have given students a platform to engage with one another outside of strict gender roles, promoting fresh viewpoints based on academic achievement and respect for one another rather than gender identity. This illustrates a wider understanding among students that the design of online learning fundamentally challenges accepted conventions. Online platforms promote equal participation for both genders, in contrast to physical settings where gender segregation is imposed spatially. This increasingly renders gender segregation in academic contexts obsolete. In light of this paper, virtual learning serves as a cultural disruptor that creates opportunities for more inclusive academic partnerships in addition to offering a technology solution. Further, this study is a powerful indication that educational content may be used as a tool for prejudice deconstruction and has a significant influence in changing social attitudes when combined with inclusive surroundings. This outcome is in line with the Saudi Vision 2030 goal of changing social standards and empowering women. In addition to giving female students additional chances, virtual learning presents women as equally

capable and academically worthy and operates as a workable solution and a representation of systemic change by creating a learning environment in which gender does not restrict access, engagement, or achievement.

It is analytically evident that virtual learning is changing Saudi Arabian society in a significant way, especially in terms of attitudes toward equality, gender interaction, and educational policy. The majority of students agree that online learning promotes gender-neutral communication, acceptance, and equity. Crucially, virtual learning is now seen as a tool for social advancement as well as a way to offer academic content. It is closing gaps in perception, trust, and cultural attitudes in addition to those in performance and access. These consequences have the ability to change community norms, impact national policy, and transform gender dynamics in various industries as they continue to accumulate. In light of the Saudi students' perspectives in this study, virtual learning is causing societal change in addition to facilitating education. Virtual platforms are changing educational norms and expectations by fostering equality, improving communication, and reducing gender segregation. With continued institutional backing and changing public opinion, virtual education has the potential to be one of the most effective means of securing a more just and cohesive Saudi future.

As for the results obtained from the teachers' interview, instructors observed that female students frequently exhibit greater involvement on virtual platforms, active participation, and superior organizing abilities. Positive responses show that social obstacles that are usually present in face-to-face mixed-gender contexts are lessened via digital interfaces. Collaboration based on academic achievement rather than gender identification is encouraged by the impersonal and task-oriented nature of online environments. The opposing opinions, however, probably represent enduring cultural reluctance and practical difficulties in moving toward inclusive approaches. The interview results also show that students' initial uneasiness, disparities in participation rates, or parents' worries about gender interaction are a few examples of reported difficulties. Despite this, the majority of respondents believe that, when managed professionally and with clear standards, virtual environments are simpler to govern in terms of gender inclusion than traditional classrooms.

Further, the majority of respondent teachers perceive virtual learning as a tool that enhances educational access, especially for female students, reduces segregation, and promotes gender equity. Instructors attest to advancements in student attitudes, communication, and possibilities, supporting the idea that digital platforms provide a competitive, inclusive substitute for conventional models. Nonetheless, the existence of certain unfavorable or doubtful reactions draws attention to persistent cultural difficulties. These include societal opposition, parental apprehension, and a lack of clarity regarding the extent to which virtual integration may proceed. These issues highlight how implementing gender-integrated virtual learning policies requires ongoing training, institutional support, and cultural sensitivity. Subsequently, the perspectives and experiences of respondents will be crucial in shaping a future in which everyone, regardless of gender, may access equality, inclusion, and academic success as Saudi Arabia moves closer to more gender integration.

6. Conclusion

This study provided an empirical investigation to explore how virtual learning supports sustainable development in the Saudi educational context. This was conducted by casting emphasis on objective number 5 of the sustainable development objectives: gender equality. The study's main focus was on the extent to which virtual learning contributes to gender equality in terms of being a gender-segregation softener. It was analytically demonstrated that virtual learning contributes positively to gender equality and softens gender segregation in the Saudi educational context. The findings of this study lend credence to the idea that students themselves are aware of and appreciate these developments. Virtual education may continue to pave the road for greater gender equity in the Saudi educational system with continued institutional support and changing cultural attitudes. Further, the study emphasized that virtual learning is crucial in changing old gender norms in Saudi education, as evidenced by the perception and attitude study of students' and teachers' responses. Female students emphasize that they are more accepting of academic equality, more open, and less biased during virtual classes. Virtual learning has shown promise as a catalyst for cultural change, far beyond its use as a stopgap measure during emergencies. It significantly advances the larger objective of gender equity in school and beyond by bridging gender gaps in inclusive, safe, and accessible ways.

7. Pedagogical Implications, Recommendations, and Limitations

Pedagogically, this study contributes to a deeper comprehension of sustainability topics in a digital learning setting and offers useful insights into a complete adoption of virtual learning as a significant softener for gender segregation in the Saudi educational context. However, addressing the issues of digital access, cultural attitudes, and the caliber of online interactions is crucial to maximizing the potential of virtual learning in this setting. The beneficial social and academic effects of virtual learning in lowering gender segregation are positively acknowledged by respondent students and teachers. Their opinions show that digital education has not only increased access but also started to change ingrained cultural norms, which is in line with actual changes taking place in the classroom. However, to maintain a long-term change, this transition is complicated and requires methodical, encouraging, and culturally sensitive techniques.

This study recommends further studies and policy development procedures to guarantee that virtual learning effectively contributes to the evolution of gender dynamics in Saudi education as follows: First, Saudi education institutions are recommended to create and implement guidelines that support online learning settings that are inclusive of all genders; second, further investments in technology infrastructure should be made to close the digital divide and guarantee equitable access to online learning materials; third, various training courses for teachers should be held to promote gender-related understanding and sensitivity in online learning environments; and, fourth, longitudinal research is recommended to evaluate the long-term effectiveness of virtual learning on gender equality and sustainable development.

The limitations of this study can be summarized in two points: first, the study uses a sample from one Saudi university, so its results cannot be generalized to all EFL contexts. This point can be improved by conducting further studies whose samples cover a large number

of universities in Saudi Arabia and in other countries that adopt segregated systems of education. Second, the study is conducted on the university stage students and teachers. This point can also be improved if future research provides similar studies on samples from pre-university education (specifically, the intermediate and secondary stages). This could reveal general results that can support the current study's assumption that virtual learning effectively contributes to gender equality by operating as a gender-segregation softener.

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