The Impact of Distance Learning on Science Education during the Pandemic

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Abstract

Following the 2019 coronavirus (COVID-19) pandemic, the role of distance learning is to substitute conventional teaching methods worldwide and to keep the education process tenacious. The purpose of this study was to explore the impact of distance learning in science education at Jordan University of Science and Technology (JUST) during the COVID-19 pandemic. This was a mixed-methods study that utilized quantitative descriptive-analytical approaches. Twenty-eight science faculty members at JUST were eligible to participate. A survey questionnaire adapted from an Irish national survey to explore the impact of the COVID-19 crisis school closures on teaching and learning science was used. Findings from this study show a significant impact of distance teaching on science education. The participants reported many obstacles and challenges, including internet connection issues and lack of experience with the new technology and teaching strategies. Moreover, 75% of the participants reported that technical problems were the most significant among other obstacles. The advantages of distance learning were also explored in this study; the participants reported gaining new techniques and teaching skills. However, the majority of the participants reported a preference for the traditional methods over distance learning and advocated for taking advantage of blended learning to improve science teaching.

Introduction

The COVID-19 pandemic is a public health emergency influencing all countries worldwide (United Nations Office for the Coordination of Humanitarian Affairs [OCHA], 2020). COVID-19 global pandemic has influenced education all over the world. World Health Organization declared that no life will revert to normal unless a vaccine is discovered. So as neediness to that pandemic on 15 March 2020, The Jordanian government ordered to close, kindergarten, schools, and universities, impacting 2.37 million learners. So, the teaching (headway) progress has been influenced (Xinhua Net,2020). The different educational institutions are obliged to conduct distance learning as a substitution to direct teaching to carry on the educational process through video conferencing applications and modules (International Labor Organization [ILO], 2020).

A reduction in average learning levels for all students, a widening of the distribution of learning achievements

due to highly unequal effects of the crisis on various populations, or a significant increase of students with a very low level of achievement due in part to massive dropouts (world bank, 2020). This suggests 25% more students may fall below a baseline level of proficiency needed to participate effectively and productively in society, and in future learning, a result of the school closures only (world bank, 2020).

A great effort was done by the Ministry of Education (MoE); Televised lessons and digital platforms (Abwab, Jo Academy, Darsak, and Edraak) have been provided to ascertain education persistence. the MoE instituted three national TV channels to broadcast and optimize reachability to the educational content, one of which is specifically designated for 12th Grade. In addition to the above, the MoE launched in partnership in collaboration with the Ministry of Digital Economy and Entrepreneurship and the development of Mawdoo3 a platform for teachers that contains 6 Massive Open Online Courses (MOOCs) from Edraak on distance learning tools, education technology, blended learning, the inverted classroom, teaching with confidence (Batshon & Shahzadeh, 2020).

Jordan was amongst the first in the MENA region to impose a foreclosure and close all educational institutions as early as mid-March. The Government of Jordan promptly answers back to these closures to minimize learning losses. The quick actions taken by the government to respond to educational necessities and advance digital learning solutions could permit a swift retrieval and recovery for the country. A key priority in supporting Jordan's COVID-19 response has been to ensure that no one is left behind by school closures and the necessary move to remote and digital learning (Blom et al., 2020).

In response to the COVID-19 pandemic, the Ministry of Higher Education at Jordan has decided that most teaching methods including the process of evaluation of students must be implemented online (distance learning) so a shift toward virtual context. Jordan (like most of the world) is unwilling to execute distance learning at this level. Therefore, many barriers and constraints have been confronting students, instructors, and the whole administrators from the head of the university to the lower-level administrators.

“From the onset of the pandemic, teachers were immediately tasked with implementing distance learning modalities, often without sufficient guidance, training, or resources” (United Nations [UN], 2020). At JUST the most majority of students are required to register for basic science courses in their first-year enrollment. With the emergence of COVID-19, a new platform was innovated to continue the teaching process at the university and to maintain the level of knowledge and skills that the student has to acquire. Moreover, Science professors are required to meet science education curricula. However, professors have doubts and challenges on how to achieve that in distance learning, and how to provide or conduct activities outside the classroom.

The reported local studies have focused on students' feedback and satisfaction with distance learning. The current study focused on the perspectives of faculty members in basic science courses, most students involved in these courses are freshmen students, with little experience of university teaching and distance learning education. The study aims to shed the light on the advantages and disadvantages of distance learning at Jordan University of Science and Technology from the perspectives of science faculty members, to improve the process

of education and overcome the current obstacles. We chose JUST to conduct this study because it is a leading university at the local level in utilizing eLearning modules in education and excellent internet and technological facilities.

To investigate the challenges and obstacles we consider the following research question in this study:

1. What is the impact of distance learning on science education at Jordan university of science and technology during the COVID-19 pandemic?

Two other questions arise from the main question:

2. What are the obstacles/challenges of distance education from the faculty members' perspectives?
3. What are the advantages and disadvantages of distance learning?

It is expected that the outcomes of this study would contribute to the literature in science education, and provide guidelines for further investigations. It also might assist teachers and educators in overcoming obstacles and challenges that are facing them during the global pandemic. Also, the results may help in the improvement and development of distance learning quality in universities and elsewhere.

Distance Learning

The philosophy of distance education is based on the learner's independence theory, with the minimum needed face-to-face teacher-student interaction, and the maximum level of personal learning materials. These have a superior extent of quality when sent by different resources, which enable a maximum number of learners (Al-Ferjani, 2002). Distance learning is not a new concept; it has expanded all over the world since the 1980s. Industrialized and developing countries as well have adopted (engaged in) distance learning (Rumble & Harry, 1982). In Europe and other Western countries, a worldwide interest was arising. And European Open University that is relying on distance learning was proposed in 1992 (Bates, 1990). The term "distance education" is first used by the University of Wisconsin–Madison in a pamphlet in 1892.

Distance learning was a unique form of education using an atypical system, but with the expedition of technology development and as a necessity of inhabitants increasing, now it is (playing) becoming a significant role in education. The transmission of learning in distance learning depends highly upon technologies (McIsaac, 2004). Distance learning education utilizes technology, which enables the majority of the individuals to learn from. As well, the extensive use of computers and the internet have made distance learning smoother and rapid (Phipps & Merisotis, 1999).

So, the embedding of technology into teaching is an important issue, and most educational institutions have and continue to designate resources to technology integration (Nelson, 2003). Even though the challenges that face the students and the teachers from distance learning, still some studies reported many advantages for distance learning as in studies; (Al-Adwan et al., 2013; Sindiani et al., 2020; Alqudah et al.,2020) found that the most advantage for distance learning was social distance. Institutions are facing noticeable challenges to counteract these challenges by resorting to distance learning systems (UNESCO, 2020a).

Distance learning is defined as providing access to the students who are physically away from the teacher (Moore et al., 2011). Distance learning requires a different time commitment compared to F2F learning. Time is vital in advance to design and develop online activities, and this is influenced by the teacher's pedagogical and organizational skills and their awareness of learning technologies. Distance learning also necessitates interaction with the students numerous times per week (Jeschofnig & Jeschofnig, 2011). Another definition of distance education is an approach to education, not an educational philosophy where students can choose their own convenient time and place to learn (at home, in the workplace, or an educational center), and without direct contact with the professor. Hence, technology is an important element in distance education (Liguori & Winkler, 2020).

Another definition of distance learning is "the process of acquiring knowledge and skills through a variety of media for the transfer of education and information, including all types of technology and various forms of education level for distance learning" (The American Association for Distance Learning [USDLA], 2004). E-Learning is a type of learning or teaching platform that depends on electronic devices and technology instead of papers and classroom teaching (Wheeler, 2012). There are two main types of e-Learning: time-independent asynchronous type, where students study from downloadable courseware at their convenient time, and the synchronous type, where real-time online learning with the ability to interact and chat with students in live conferences is scheduled at set times (Merzouk et al., 2014). There are many distance learning choices; like video conferences, synchronous learning, asynchronous learning, open-schedule, fixed-time, computer-based, and hybrid learning.

Distance learning can broaden access to education since it is flexible (Oblinger, 2000). Furthermore, there is also the possibility of improved access to more specialists in the topic as well as students from a variety of geographical, social, cultural, economic, and experiential backgrounds (Maggio et al., 2001). Moreover, Institutional innovation can be sparked through distance education programs, which are at least as effective as face-to-face learning programs (Blackmore et al., 2007). Within the sphere of education, distance education can also give a larger manner of communication (Masson, 2014). The rise in communication in distance education, particularly among students and their classmates, is an enhancement intended to provide distance education students with as many possibilities as feasible that they would obtain in-person education. The developments in distance education are keeping pace with the rapid advancements in technology. According to studies, when learners become aware of the disparities in interpretation and construction of meaning among a range of persons, they develop an individual meaning, which can assist students in becoming informed about a variety of educational ideas. As well, distance education has proven to be a more cost-effective mode of instruction, saving students large amounts of money when compared to traditional schooling. Furthermore, Given the personal demands on time and schedule, the opportunity to complete a course at a speed that is right for each individual is the most successful method of learning. Self-paced distance learning on a mobile device, such as a smartphone, allows maximum flexibility and capabilities (Masson, 2014). On the contrary, domestic distractions and unreliable technology, as well as students' program expenditures, proper communication with teachers and support services, and a need for more expertise, are all barriers to effective distance education (Galusha, 2000).

Adopting distance e-learning in different fields of knowledge in low and middle-income countries (e.g., Jordan) can add a great benefit to achieve 2030 SDGs (Al-Balas et al., 2020). The use of technology has been increased for adaptation of the emergency (Jeschofnig & Jeschofnig, 2011). Technological advances have stimulated learning by integrating new approaches into the education environment. Educators look forward to immersing a classroom community in online teaching and learning which incorporates both topic and content. Students should be motivated to continue their education on an electronic platform while dealing with the challenges of the global epidemic (Boothe, 2021). However, In the Jordanian community using technology is still a problem in distance learning because of the students' and teachers' experience in using technology varied.

Before Covid-19 a little research was conducted to see the impact of distance learning on science education, but a lot of studies during the pandemic and till now are performed. Al Darayseh (2020) conducted a study in UAE schools to investigate the impact of COVID-19 on modes of teaching science. A qualitative method was applied to achieve the goals of the study. An open-ended questionnaire was allocated to a sample of (62) science teachers through an online platform. The results revealed that the COVID-19 crisis-affected science education. They recommend that the digital qualifications of the teachers have to be improved, and students should be more engaged in the teaching process.

Abushokheedem et al. (2020) carried out a study to explore the effectiveness of e-learning from Khadouri University instructors' perspective. A descriptive-analytical approach was used in the study. The sample consisted of (50) instructors in different disciplines. The study included four elements of education by eLearning; effectiveness, evaluation, obstacles, and interaction. A questionnaire with reliability (0.804) was designed and applied to gather information about these four educational elements. The results showed a medium impact of eLearning in all educational parameters under investigation.

A local study was performed by Al-Balas et al. (2020) to investigate the impact of distance learning in clinical medical education during the COVID-19 pandemic in Jordan. A questionnaire was applied to a sample consisted of (652) medical students in their clinical years. The overall students' satisfaction rate in distance learning was low (26.8%), however, students with prior experience in distance learning express significantly higher satisfaction (40%). In addition, higher satisfaction was also observed when instructors were actively participating in learning sessions, using multimedia, and devoting adequate time for their sessions.

Another study was done by Sindiani et al. (2020) to assess distance education among medical students in Jordan. A survey was applied to (3700) students. The results indicated that most medical students at Jordan University of Science and Technology preferred the traditional teaching method over the online teaching methods with recommendations to convert to a more integrated educational system. Also, a well-established infrastructure should be done involving online teaching.

Some other investigation was conducted by Unger and Meiran (2020). COVID-19 was used to examine undergraduate student views on swiftly transitioning to an all-online learning environment. In addition,

questionnaires on perceptions of media disinformation, overall anxiety toward remote learning, disease outbreak awareness, and level of preparedness for the Coronavirus (COVID-19) 2020 outbreak were studied. During the COVID-19 2020 crisis, Wingate undergraduate students from various majors and academic years were questioned (N = 82) as part of an animal behavior course that covered psychology and human behavior during the first two weeks when students returned to school online from off-campus. The majority of students (91.5%) said that online learning will be different from in-class learning, demonstrating a wide gap in replies. Many students (98.8%) said they had seen some COVID-19 misinformation in the media, and there was a substantial difference between student perceptions of being well informed from traditional news sources (e.g., TV, newspapers) versus social media. Many students (75.6%) expressed concern about quickly transitioning to complete a semester online, with 84.2% actively discussing disease transmission and just 64.6% feeling well prepared for emergencies. The majority of students said that precautionary steps (such as the institution asking students to move off-campus and moving the remainder of the semester to online distance learning) were necessary. Overall, students who freely responded to the survey expressed a wide range of emotions, with the majority expressing fear about online learning, disappointment about the graduation ceremony, and the fact that online learning differs from traditional in-class learning. After 3 weeks, a follow-up survey with one question demonstrated an improvement in students who said they were less anxious about online learning (51.4% Yes: 48.6% No), although many students still expressed anxiety about distant education.

A research was carried out by Niemi and Kousa (2020). During the COVID-19 outbreak in Finland, this report describes one local upper secondary school. For almost two months, all classes were moved to the distance. During that time, the research describes students' and teachers' perceptions. Four times, participants completed the survey, and five times, they freely reported their experiences. The number of pupils who took part ranged from 56 to 72, with 9 to 15 teachers. The results indicate that distance teaching was implemented very successfully. Open comments and cluster analysis, on the other hand, showed a slew of issues. Students expressed their dissatisfaction with their workloads and tiredness. Some students had lost interest. These problems did not go away with time. Non-authentic contact and a lack of the spontaneity that in-person teaching provides were the biggest obstacles for teachers. Teachers quickly learned to use technology platforms, but the level of engagement was not as good. Teachers were concerned about their students' achievement as well. Teachers failed to identify students' severe workloads and motivation issues as students described them. Several suggestions for future remote instruction were made.

Rahman and Buck (2021) conducted a study. The goal of the study was to learn more about International Teaching Assistant’s (ITA's) issues and challenges in the context of a sudden, seemingly intractable disruption in science instruction in higher education in the Midwest. A self-study method was used. The following sources of information were used to compile the data for this study: 1) an instructor's journal, 2) critical-friend interviews, 3) observations, and 4) written materials. Thematic analysis was used to evaluate all of the data after it was transcribed, organized, and processed. The findings of the study, remote scientific education are less participatory and effective than traditional methods of teaching, the instructor noted that she learned about numerous approaches to teaching, online technologies, and resources to promote remote learning. On the contrary, this self-study has highlighted some of an ITA's sociocultural, psychological, and educational

problems, as well as how those struggles influence her teaching and emotions in COVID 19.

Ilhan et al., (2021) conducted a study. The study's goal is to find out how digital comics content affects students' academic progress, as well as their opinions on distance education, courses, and digital comics. The research was conducted using a mixed-methods approach. The quantitative component of the study was designed as a single-group experimental study, with an academic achievement exam administered before and after the study. Phenomenology was used in the qualitative dimension, and data was acquired through audio-recorded interviews. The research's quantitative study group consisted of ten people. The research's quantitative study group comprises ten students, while the qualitative phase consists of five. In the quantitative phase, the data was evaluated using a statistical tool, and in the qualitative phase, content analysis was used. As a consequence of the study, it was determined that using digital comics in remote education promotes success and aids in the development of students.

Altowairiki (2021) conducted a study to investigate online collaborative learning: analyzing the process through living the experience. It is necessary to include stakeholders' opinions on their lived experiences to comprehend online collaborative learning. The investigation was carried out using a qualitative case study. The study included two online graduate courses on purpose. Students and instructors were observed online and data was gathered through semi-structured interviews. A constant comparative analysis method was used to examine the acquired data. Multiple proactive supports (i.e., social, pedagogical, and technical support) play significant roles in developing purposeful teamwork. The presence of the instructor is critical in facilitating collaboration by setting the tone, modeling desired expectations and encouraging students to achieve desired goals. Assessments have an impact on students' levels of involvement; as a result, it is advised that both formative and summative assessments be used for both the product and the collaborative process.

The COVID-19 crisis has changed the process of teaching at universities. And has an extreme effect on basic and applied science course teaching since teaching in these fields required direct observations, demonstration, and practical work where face-to-face teaching is crucial to achieving all learning objectives (knowledge, skills, and applications) in these disciplines. Since delivering online lectures becomes obligatory under the current many challenges and obstacles had faced faculty members, and students as well. Previous instances of governments and universities responding to emergencies have only supplied a limited amount of information about the shift to online learning. However, there is currently little study on how students are affected when universities close temporarily and unexpectedly and students are forced to join online learning communities.

The Research Designs

The research aims to explore the science faculty members' perspectives towards distance learning. The goal of the study was to draw up a broader insight into distance learning. Educators and online professors may build a positive learning experience by understanding the distance learning from and professors' lived experiences. A mixed research method was used purposefully to answer the question of the research.

Method

The study implemented a descriptive and quantitative method. Afterward, an email was sent to Dr. Chadwick asking for authorization to utilize the survey that she designed and applied in her study. Data were collected using a Likert scale questionnaire and open-ended questions.

To suit the Jordanian community, the questionnaire was amended. A structured questionnaire composed of (14) questions was developed using Microsoft forms. Thereafter, it was administered to science faculty members at Jordan University of Science and Technology. The survey was distributed by email and social media (WhatsApp and Facebook) from (15th Jan) to date (22nd Jan) faculty members completed the online survey. The total number of valid questionnaires is (14), giving a response rate of around (100%). The majority of respondents (82.14%) were males. Subsequently, the data were collected, and then analyzed using Statistical Package for Social Sciences (SPSS), and thematic analysis.

Tool Validity and Reliability

The questionnaire is valid and reliable, as mentioned before the survey questionnaire for this study was adapted from an Irish national survey used to explore the impact of the COVID-19 crisis school closures on teaching and learning science.

Study Group

The study involved (28) science faculty members; of which (3) were female and only (25) male. The explanation of the gender variable inequality in this study is that the number of male faculty members is higher than female faculty members at JUST.

Questionnaire Structure

Questionnaire content is as follows:

- Section (1) Questions 1-3 are related to the faculty members' information
- Section (2) Questions 4-6 the impact of the university's closures, during the COVID-19 crisis, on your teaching and assessment in science.
- The question number (5) related to science education and the obstacles that facing faculty and students in distance teaching
- Question number (6) in your opinion, what have been the positive aspects of learning, teaching, and assessment in science during the COVID-19 university closures?
- Section (3) Questions 7-9 about the use of learning technologies
- Section (4) Questions 10-13 Facilitation of practical work in science
- Question 14 Choose between distance teaching and traditional methods

Statistical Analysis

For statistical analysis, SPSS 23 version was used. The percentage was used in question number 1, Frequencies for question number 2, means and standard deviation was calculated in questions number 4, 5 & 8, for questions number 6,12 & 13 thematic analysis. A Wilcoxon test in questions 7 & 10. The number and percentage of responses in questions number 8 & 11. the number of responses in question number 9. The frequency and percentage of responses in question number 14.

Results

The findings discussed in this section related to the demographic information; specifically, the gender of the faculty members, number of years of experience. Each of these aspects is clarified in the next portion.

Findings Related to the Demographic Information

Figure 1 shows that the distribution of faculty members related to gender; the number of male respondents was 23 (82.14%), larger than the number of female respondents 5 (17.86%).

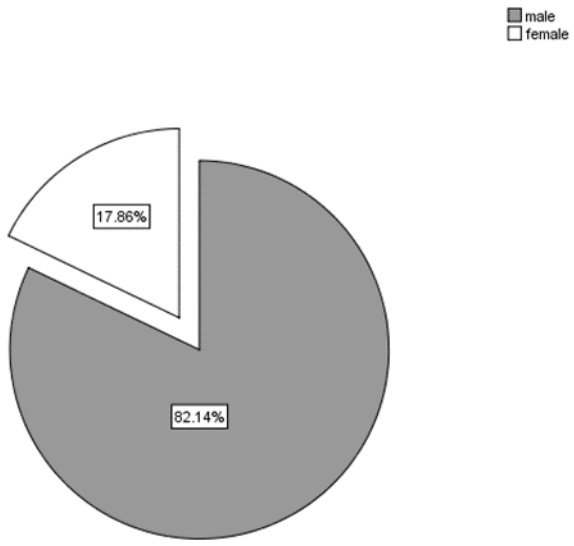

Figure 1. Distribution of Faculty Members by Gender

Results of Question 2: How many years of teaching experience?

To answer this question, the frequency (the percentage) of experience years of faculty members was calculated, as shown in Table 1.

Table 1. Frequency and Percentage of Experience Years of Faculty Members

Experience by years	Frequency	Percent
5-10 years	4	14.3%
11-20 years	9	32.1%
more than 20 years	15	53.6%
Total	28	100.0

Table 1 shows that the major number of faculty members with an experience of more than 20 years formed the higher percentage (53.6%), followed by (32.1%) of faculty members with less than 20 years' experience.

Results of Question 4

This section asks about the impact of the university's closures, during the COVID-19 crisis, on your teaching and assessment in science. To answer the question, the mean for each item was calculated, and so the total means using Statistical Package for the Social Sciences (SPSS), as shown in Table 2.

Table 2. Mean Impact on Four Aspects of University Closure on Science Education

Aspects of learning & teaching science	Very negative impact	Somewhat negative impact	Neutral /no impact	Somewhat positive impact	Very positive impact	Mean	SD	Asymp. Sig. (2-tailed)	Rank
Support student learning in general	2	10	6	9	1	2.89	1.07	0.001	1
Differentiate	5	7	9	6	1	2.68	1.12	0.016	3
Assess	3	10	7	7	1	2.75	1.08	0.001	2
Facilitate	8	7	6	7	0	2.43	1.17	0.022	4
Mean						**2.69**			
SD						**0.95**			

Table 2 above shows that the highest mean (2.89) with the standard deviation (1.07) was awarded to the item (support student learning in general), followed by item number 3 (assess) with a mean (2.75) and standard deviation (1.08), followed by item number 2 (differentiate) with a mean (2.68) and standard deviation (1.12), while the lowest mean was for item number 4 (facilitate) with a mean (2.43) and standard deviation (1.17), all of the aspects considered to have a medium impact on science education. and the weighted mean for the whole section was (2.69) and standard deviation (0.95). That indicates there is a medium impact of COVID-19 crisis on teaching and learning science, since (2.69) lies in the interval (2.6-3.4) or (2.60-3.39). Table 2 also shows that the mean difference between the means of the items of learning and teaching science is significant since the p-value is less than 0.05 for all items (support students learning in general, differentiate, assess, facilitate practical).

Results of Question 5: What are the obstacles/challenges of distance education from the faculty member's perspectives?

To answer this question, the means and standard deviation calculated for each item in this question, and the whole area; the obstacles of distance education from the faculty member's perspectives as in Table 3.

Table 3. Descriptive Statistics of the Obstacles in Teaching Science that Faculty Face During COVID-19 University Closure

Item	Strongly agree	Agree	Neutral/no impact	Disagree	Strongly disagree	Mean	SD	Asymp. Sig. (2-tailed)	Rank
Technical problems (e.g., internet access, unavailable devices.... etc.)	5	13	6	4	0	2.32	0.94	0.000	3
Resources of online materials	1	8	9	9	1	3.04	.096	0.006	2
Personal experience	0	12	8	3	5	3.04	1.14	0.000	2
Technical support & assistant	0	9	10	6	3	3.11	0.99	0.001	1
Mean						**2.88**			
SD						**0.74**			

Table 3 shows that the highest mean (3.11) with the standard deviation (0.99) was awarded to item 4 (Technical support & assistant), followed by items number 2 & 3 (Resources of online materials & Personal experience) with a mean (3.04) and standard deviation (0.096 & 1.14 respectively), followed by item number 1 (Technical problems) with the least mean (2.32) and standard deviation 0.94, and the weighted mean for this section was (2.88) and standard deviation (0.74). That indicates some obstacles face faculty of the moderate impact of COVID-19 crisis on, since (2.88) lies in the interval (2.60-3.39), as in Table 4.

Table 4. Intervals of Likert Scale

Response	Interval	level
Strongly disagree	1-1.79	Low
Disagree	1.80-2.59	
Neutral	2.60-3.39	Moderate
Agree	3.40-4.19	High
Strongly agree	4.20-5	

All the values of P are less than 0.05 which means that the value is significant; which leads to rejection of the

null hypothesis that is there is no significant difference between the means of four aspects of obstacles in teaching science that faculty face during COVID-19 university closure.

Results of Questions Number 6 & 12 & 13

Which was about your opinion, what have been the positive aspects of learning, teaching, and assessment in science during the COVID-19 university closures? To answer these questions, the responses were analyzed thematically (see Table 5). Four themes were addressed using thematic analysis: these are, knowledge and skills, net issues, student-instructor interaction, and infection. From each theme, subthemes emerged.

Table 5. Themes and Subthemes Identified from Thematic Analysis

Themes	Subthemes
Knowledge and skills	a. Developing skills and knowledge
	b. Introducing new teaching methods
	c. Student autonomy
	d. Cannot be applied to practical activities
	e. Difficult to convey lecture as a traditional method
Net issues	a. The net is not available all the time
	b. Weak internet connection
	c. Poor students cannot have net access
	d. Time-consuming
Student-instructor interaction	a. Less interaction
	b. Difficult to follow up with students
	c. Attendance problems
Infection	a. Minimize infection

Based on faculty's perspectives, (39.3%) of them think that there is no advantage of distance learning, while (32%) of the faculty believe that they are developing skills and knowledge, whereas (10.7%) consider the student autonomy is one of the advantages of distance learning (see Table 6). Also, the least percentage was reported for reducing infection, saving time, and fair for students; 7.1%, 3.6%, 3.6% respectively. But the challenges in facilitating practical work that the faculty members stated are doing the experiments which was the highest percentage (17.9%), followed by student-teacher interaction (10.7%), then (7.1%) percent was for students follow up and attendance and the least percentage was for difficult, time and exams although the majority (71.4%) of the faculty members agreed that nothing positive in distance learning.

Table 6. Advantages and Disadvantages of Distance Learning

Advantages of distance teaching	No. of respondents (%)
nothing	11 (39.3%)
Developing skills and knowledge	9 (32%)
Student autonomy	3 (10.7%)
Reduce infection	2 (7.1%)
Safe time	1 (3.6%)
Fair for the students	1 (3.6%)
Challenges in facilitating practical work	
Not applied	7 (25%)
Net issues	7 (25%)
Student-teacher interaction	3 (10.7%)
Students follow up and attendance	2 (7.1%)
Doing experiments	5 (17.9%)
difficult	1 (3.6%)
Time	1 (3.6%)
exams	1 (3.6%)
Positive aspects in practical activities	
nothing	20 (71.4%)
Application of new teaching technologies and methods	4 (14.3%)
Minimize the effect of closure	1 (3.6%)
Save money	1 (3.6%)
Attendance	1 (3.6%)

Results of Question 7: Use of Learning Technologies

This section asks about the use of learning technologies in science education before and during the COVID-19 crisis. How often did you use learning technologies (e.g. Zoom, Email, Teams, Google Apps, Social Media, Others)? A Wilcoxon test was used to identify the impact in the week leading up to COVID-19 and during COVID-19. A two-tailed test significant was 0.000, which indicates rejection of the null hypothesis that is, there are no significant differences between the means in using technology in the week leading up to COVID-19 and during COVID-19, and accepting the alternative hypothesis that says there are significant differences between the means in using technology in the week leading up to COVID-19 and during COVID-19 (see Table 7).

Figure 2 and Table 7 showed that using learning technology in the week leading up to COVID-19 university closure was sometimes, compared to very often during the COVID-19 University closure as shown in Figure 3. It shifts the mean from 2.64 in the week before COVID-19 to 4.46 during COVID-19 (see Table 7). 39.3% of the faculty sometimes use learning technology in the week leading up to, compared to an increase to 67.9% of the faculty very often using learning technology during COVID-19 (see Figure 2 & 3).

Table 7. Descriptive Statistics of Using Technology in the Week Leading up and During COVID-19

	N	Mean	Std. Deviation	Asymp. Sig. (2-tailed)
In the week leading up	28	2.6429	1.12922	0.007[c]
During COVID-19	28	4.4643	.92224	0.000[c]
Valid N (listwise)	28			

c. Lilliefors Significance Correction.

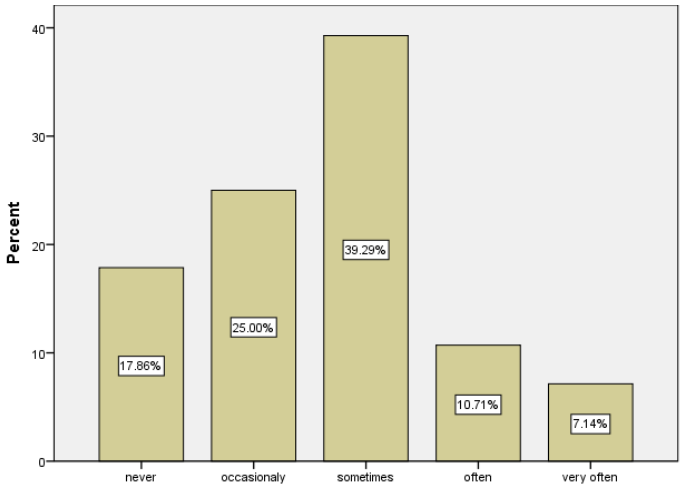

Figure 2. Percentage of Using Learning Technology in the Week Leading up to COVID-19

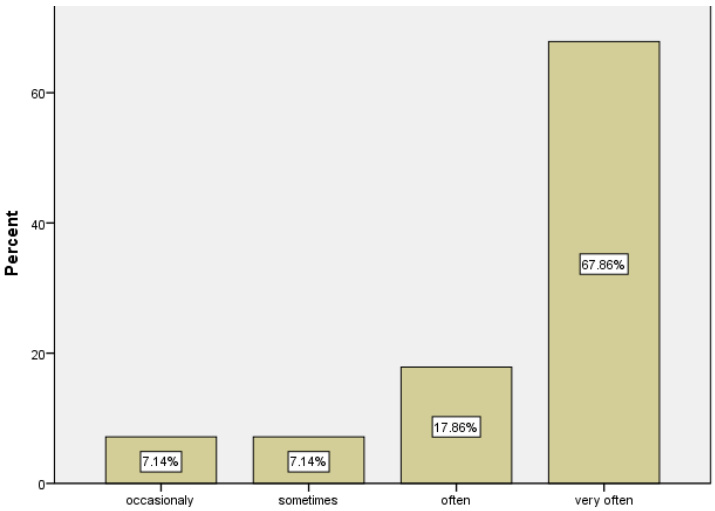

Figure 3. Percentage of Using Learning Technology During COVID-19 Pandemic

Results of Question 8: Which learning technologies did you use?

To answer this question, the number and percentage of responses were calculated, and the mean and standard deviation were calculated as well (see Figure 4 & Table 8).

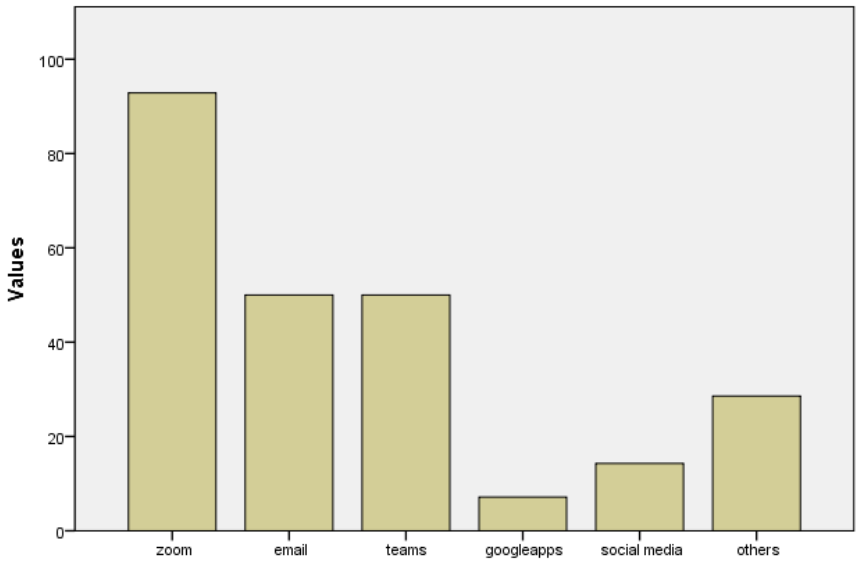

Figure 4. Frequency of Using Teaching Technology

As shown in Figure 4 and Table 8, the dominant learning technology used was Zoom (92.9%), followed by Teams as well as an email that formed (50%), then others (28.6%), and the least learning technologies that were used are social media and Google Apps (14.3% & 7.1% respectively).

Table 8. Using Technology Frequencies and Percentages

Teaching technology		Responses		Percent of Cases	Mean	SD
		N	Percent			
using technology	zoom	26	38.2%	92.9%	.9286	.26227
	email	14	20.6%	50.0%	.5000	.50918
	teams	14	20.6%	50.0%	.5000	.50918
	Google apps	2	2.9%	7.1%	.0714	.26227
	Social media	4	5.9%	14.3%	.1429	.35635
	others	8	11.8%	28.6%	.2857	.46004
Total		68	100.0%	242.9%		

Results of Question 9: What did you use learning technologies for?

To answer the question, the number of responses was calculated, and so the percentage is in Figure 5. The figure shows that learning technologies mostly used for different purposes; such as exams and quizzes (96.3% & 74.07% respectively) were the highest, and for assignments, group discussion, demonstration videos, and chatting, dividing groups and other purposes with different percentages.

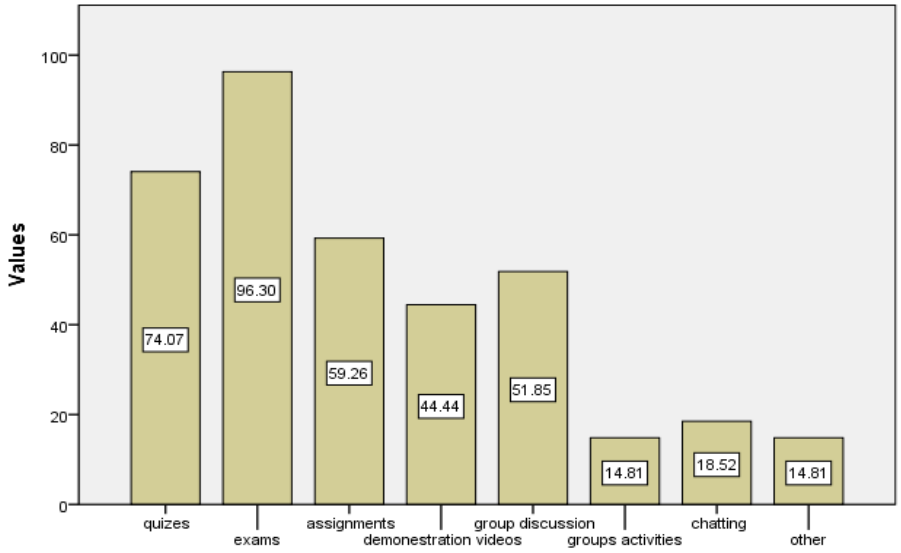

Figure 5. Percentage of Using Technology for Different Purposes

Results Question 10

Facilitation of practical work in science this section asks about your experience facilitating practical activities in science during the COVID-19 university closures (e.g. experiments, lab-work, field-work, videos, animation, simulations, or other activities). How often did you facilitate students carrying out practical activities online?
A Wilcoxon test was used as a parametric test to reveal the facilitation of practical work in the week leading to COVID-19 and during COVID-19. The results are shown in the following Tables 9 and 10.

Table 9. Facilitation of Practical Online Work in the Week before and during COVID-19

	Mean	Standard Deviation	Sig. (2-tailed)
In the week before COVID-19	2.11	0.99	0.003
During COVID-19	3.25	1.37	

Table 10 shows that the p-value is less than 0.05 which means rejection of the null hypothesis that refers to there is no significant difference between the means of the week before COVID-19 and during COVID-19, which leads to accepting the alternative hypothesis that refers to that there is a significant difference between the means of the week before COVID-19 and during COVID-19. The results showed that there was a shift in carrying out practical activities online from (2.1) in the week leading to COVID-19 to (3.25) During COVID-19 (see Table 9). These results are predicted to keep the teaching process on without disruption.

Table 10. One-Sample Kolmogorov-Smirnov Test

		In the week before COVID-19	During COVID-19
Normal Parameters[a,b]	**Mean**	**2.1071**	**3.2500**
	Std. Deviation	**.99403**	**1.37773**
Most Extreme Differences	Absolute	.221	.178
	Positive	.221	.127
	Negative	-.137-	-.178-
Test Statistic		.221	.178
Asymp. Sig. (2-tailed)		**.001[c]**	**.023[c]**

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

Results of Question 11: Which of the following practical activities have you used with your students since the COVID-19 university closures?

To answer this question, the number and percentage of responses were calculated as in Table 11.

Table 11. Practical Activities Use Frequencies

		Responses		Percent of Cases	Rank
		N	Percent		
Practical use	Fieldwork	1	3.6%	3.7%	4
	Video demonstration	17	60.7%	63.0%	1
	Inter-active simulations	4	14.3%	14.8%	3
	others	6	21.4%	22.2%	2
Total		28	100.0%	103.7%	

Table 11 shows that video demonstration has the highest percentage of use for practical activities (62.96%), Followed by other tools with a percentage of (22.22%), then interactive simulation (14.81%), and the least percentage was awarded for fieldwork (3.7%).

Results of Question 14: If you have the choice to choose between distance teaching and traditional methods, which one do you choose?

To answer this question, the frequency and percentage of responses were calculated as in Table 12.

Table 12. Frequency and Percentage of Distance or Blended learning

	Frequency	Percent	Valid Percent	Cumulative Percent
Traditional	21	75.0	75.0	75.0
Blended	7	25.0	25.0	100.0
Total	28	100.0	100.0	

Table 12 shows that 75% of the faculty prefers the traditional teaching method over distance teaching, while 25% of the respondents prefer the blended teaching method.

Discussion

The current study aimed at investigating the impact of distance learning in science education at JUST during the COVID-19 pandemic. Distance e-learning, which is a relatively new approach, is a budding situation in the teaching process that universities are poorly prepared to implement. During the COVID-19 pandemic, distance e-learning has evolved as a new form of teaching to ensure educational continuity. We investigated faculty members' perceptions on significant obstacles they had throughout their new teaching experience, restrictions, the benefits and drawbacks, general satisfaction, and future perspectives in this study.

The results of the study showed the impact of distance teaching on students of Science and Technology University, as well as on the faculty members. The results indicated that there is a medium impact on teaching and assessment of science. In harmony with another study, the use of teaching technologies increased during the COVID-19 pandemic (Chadwick & McLoughlin, 2020). During the COVID-19 pandemic, faculty members were forced to embed distance science teaching, the results of this study founded a medium impact of university closure on science teaching. In line with other studies, the use of learning technology has increased significantly during the COVID-19 pandemic (Niemi & Kousa, 2020; Chadwick & McLoughlin, 2020; Al-Balas et al., 2020; Aboshukeedem, 2020). Zoom was the most commonly utilized learning technology, because the faculty found it easy to use, and interfaced with the university eLearning system. And this result is in line with Al-Balas et al. (2020) social media and Google Apps were the least, this may be due to many reasons, such as they are not prepared for education also lack teaching and learning tools. And the new technologies are used for assessments and evaluation of the students because they are safeguarded by the university.

In this study, we explored science faculty's feedback towards the major obstacles and challenges that they tackled during their distance learning experience. Getting familiar with the new technologies was not straightforward for the faculty nor the students, internet access was one of the major problems and so many technical problems, also attendance problems and interaction as well, in agreement with (Carter et al., 2021; Niemi & Kousa, 2020; Rahman & Buck, 2021; Serhan, 2021). All these challenges are expected since the endorsement of technology by the university in a short while, and by the faculty who were not conversant with the new technologies. Also, since the implementation of new teaching strategies in that short period was not easy for the faculty, it needs time to get well-known by the faculty members.

In other words, most of the faculty (75%) agreed that technical problem was an obstacle, and this may be explained by not all the faculty have the same access to the internet, or the faculty live in different areas that are varied in receiving internet services; some areas are better than others, followed by (42.9%) of the faculty agreed that they found personal experience is an obstacle, compared to (28.6%) disagreed that it is a problem, and this can be due to each individual's experience differ from one to one, that has many factors on one's experience;(age, ability to learn new technology, familiarity with technology, interest in technology). (32.1%) of them found technical support and assistance is a problem, and this may be explained that some of the faculty get support and assistance when needed, while the majority did not get any support, and this difference in response may be to the pressure that the technicians exposed to during this critical period, or maybe to the limited number of technicians who are responsible to provide service and technical support. Moreover, (32.1%) of the faculty found resources of online materials an obstacle, this could be due to sudden changes in education without previous planning and preparations, in Jordan and most countries distance education is not common and has not been approved by the ministry of higher education.

It was difficult for some of the faculty members to embed technology into teaching, and that may be owing to age; young faculty are more interested in new technology, while older people do not have the curiosity to the high-tech, and maybe getting bored easily if trying to learn new skills. As a result, there is a need for adequate preparation and continuing support to aid students, given that individuals' course expectations, experiences, and talents vary. Adopting techniques to promote this variety can assist teachers in thoughtfully setting the environment for collaboration (Altowairiki, 2021).

While some faculty members have endorsed the technology eagerly, others have been much slower to accommodate new technologies into their teaching. Some of them were hesitant in applying technology in teaching (Cuban, 2001; Morgan, 2003; Walsh, 1993). So it is necessary to keep faculty developed, highly qualified, and professional by preparing training programs consistently to cope with any future emergency.

In addition, the results illustrated that the university closure affected the facilitation of practical work negatively and there was a significant difference between the means of the facilitation of practical activities online in the week prior and during COVID-19 with the higher mean for the last. Yilmaz Ince et al. (2020) agreed with that and stated, distance education can be used in theoretical aspects of courses or select courses, according to academics, but it will not be successful in applied courses. Academics who responded to the open-ended questions according to the study were unable to complete the laboratory and workshop activities of the classes. In the current study video demonstrations and interactive simulations were the highest among other technologies to use for practical activities, and this may be due to more reliable tools more than any other tool for both instructors and students. Videos can be edited, modified, corrected anytime by the instructors, and can also be reviewed by students anytime. These results are in line with the results of Chadwick and McLoughlin's (2020) research.

The findings of the current study indicated many advantages of distance learning, from the responses of the faculty members, as easy access to the internet, flexibility, low cost, more pace for the student was given,

introducing new learning technologies and methods, minimizing the effect of university closure and convenience to time and space for both faculty and students, the students can revise the material anytime. Some of the reported responses found that the only advantage of distance learning is the prevention of infection. These results go with the results of the Alqudah et al. (2020) study and Yilmaz Ince et al. (2020). In contrast with the disadvantages that have been shown; it was difficult to follow up the students and attendance, bad internet connections, not all students can get access to the lecture since they are poor, in addition to attendance problems. The teaching technologies are used for students' evaluation for different purposes most notably exams and quizzes, because they are protected by the university's internet system, and connected with the university registration department.

In addition, faculty members can get assistance or technical support in using these soft wares or in the case of facing problems, and the evaluation process can be trusted. The results reported that the majority of science faculty members prefer the traditional teaching method. That may be due to many reasons; the traditional teaching method offering more interaction between the students and the faculty enjoyable, easier to follow students.

Conclusion

Education is one of the basic crucial rights of human rights, and influencing all other rights, and during the CVID-19 pandemic, enormous work has been done in a short while to reduce the impact of the educational institutions' shutdown (United Nations, 2020). To make up for education disruption in universities and to maintain the durability of education, the ministry of higher education decided to implement distance teaching. Notwithstanding The majority of the faculty members at JUST agreed that distance learning cannot substitute the conventional teaching methods. On the contrary, they proposed that blended learning can be implemented to improve students' achievement.

The results in this study indicated that the COVID-19 pandemic had a medium impact on science education at Jordan University of Science and Technology. Distance learning explored many challenges in teaching science; being familiar with technology was not easy, both the students and the faculty faced technical problems, internet access, and other problems, and facilitation of practical activities influenced negatively. Also, the results explored that the faculty members highly preferring the traditional teaching method over distance learning for many reasons. New teaching technologies have been learned by faculty and students, students especially foreign students have less pressure than if they attend a face to face lectures, they don't have to travel from country to country to attend lectures, and less cost. The students can review the materials anytime and go through them over and over for more understanding.

Recommendations

Because the current study was done at a small university, it may be difficult to extrapolate the findings to larger states or universities, or even other private universities and schools, owing to the small sample size. Researchers

can conduct larger surveys in the future to examine faculty and student reactions to the COVID-19 epidemic. As a result, future research should include more faculty members from a variety of majors not only science, to expand the sample size and explore potential changes in faculty perceptions of distant learning.

In the light of the results, the following recommendations have been suggested:

- The results of this study may serve the policymakers and the ministry of higher education to reassess the distance teaching in science education in Jordan.
- Further future studies are recommended on other universities to reveal the impact of distance learning on teaching and other subjects.
- It is necessary to train the faculty for the new teaching technologies and keep them up-to-date with them, so the faculty are always well prepared and supported.
- New teaching methods and strategies and assessment methods are necessary to implement.

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