Asian Journal of Distance Education

COVID-19 and the Digital Transformation of Saudi Higher Education

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Abstract: This paper examines the effectiveness of the fourth industrial revolution technologies in mitigating the COVID-19 effects on higher education, through using digital learning and technological work systems as substitutes for traditional learning and work systems in Saudi Arabia. However, due to COVID-19 pandemic, all universities shut down and continued its role of providing educational services and keeping work going on using digital learning and technological work systems. Using a survey implemented in different universities for various colleges directed to faculty staff and students, the study tries to explain how the fourth industrial revolution is influencing higher education and how universities are prepared to face their challenges resulted from COVID-19 pandemic in Saudi Arabia. The study tries to explain how the fourth industrial revolution can play the role of catalyst for improving productivity, learning outcome, and wellbeing -work environment in these uncertain circumstances. Results display that digital learning is distinct compared to traditional learning, it improves the students learning outcome, enhance the faculty member's capabilities and implementation of technical systems, develops staff productivity and work environment.

Keywords: Higher Education, Digital Learning, Technological Change, COVID-19, Saudi Arabia.

Introduction

Today we are living a global, important, and complex technological progress involving change in the public sector, private sector, academic sphere, and civil society. A new chapter in the human development derived from the fourth industrial revolution (4IR) showing that it is not just a "*technology-driven change, but it is an opportunity to help everyone, including leaders, policy-makers and people from all income groups and nations, to harness converging technologies in order to create an inclusive, human-centred future*" (Pombo et al. 2018). The fourth industrial revolution, known as the digital revolution, characterized by a fusion of technologies in economic, social, and human environments. "Schwab, from the World Economic Forum, is the first person to introduce the world to the concept of the 4IR, and he does it through his book "Shaping the future of the fourth industrial revolution".

The idea born since the early of 2000s with Germany manufacturing industry and seems to be fundamentally different. It characterized the speed and original technologies, which are merging the physical, digital and biological worlds, affecting all domains, economies, industries, and humans. The most important key tools that are mainly driving this merger: Artificial Intelligence, the Internet of Things, Augmented and Virtual Reality, Nanotechnology, 3D Printing, Advanced Robotics, Quantum Computing and Energy Storage (Brown-Martin, 2018). Keeping all these introduced digital systems, the COVID-19 Pandemic, originated from Asia since December 2019 and continues to spread globally as there have been 6,194,533 confirmed cases in more than 200 countries around the World, including 376,320 deaths, reported to Word Health Organization by 2 June 2020. The global outbreak brought a lot of economic and socio-economic uncertainties and change healthy lifestyle practices. Governments around the world are forced to respond and reduce its tremendous effects on all live aspects, higher education is one of the sectors, which is strongly affected by the consequences of this pandemic.

Universities in Saudi Arabia have shut down its doors, ceased all its traditional services of learning, and turned to use digital learning and technological distance work systems. They make use of the digital systems provided by the 4IR and applied the most appropriate learning systems, and its work is running fluently throughout the different academic and administrative levels following the technological communication and work systems.

The 4IR has lately entered the implementation phase in the GCC region, and Saudi Arabia's Vision 2030 illustrates a good opportunity to benefit from it as is considered one of the most significant engine drivers unlocking major economic purpose and enabling the diversification, that Saudi economy requires going forward under Vision 2030. The Minister of Communications and Information Technology has pointed out that 4IR will be essential in achieving Vision 2030 objectives, given that the Kingdom is undergoing a process of comprehensive change and reform at all levels. Based on Hannon and Peterson (2017) reflexes, education should be the driver of learning to thrive in a transforming world, interventions are required to catalyze theses transformation within the education sector to build upon the impressive lead that Saudi Arabia is implementing in the quality supply of education. Actions that support inclusive teaching approaches and continual learning experiences relevant to the challenges that should be identified today and anticipate for tomorrow. Lifelong inclusive and equitable quality education, formal and informal, physical and digital, will be vital in preparing our populations and society to succeed in this uncertain and complex future. Difficult times, which countries and Saudi Arabia are, exposed to during the COVID-19 Pandemic, make the digital learning and technological work systems the alternatives of all traditional learning and workplace features.

The need to up-qualify and re-qualify the workforce is necessitating active and reactive education, teaching and training structures. The modifications are not only affecting upon higher education students by the way of where and how they will work and continue to learn across their vocations, but also upon how education system offers those on-going learning opportunities. The quickly moving skills landscape of the world workforce means that permanent learning needs to grow more rapidly to meet the envisaged economic and social transformations. In this context, this paper tries to examine the impact of the 4IR on higher education among member faculties and students on productivity, learning outcome and its implications on work environment in Saudi Arabia. Using a survey implemented in different universities for various colleges, the study efforts to explain how the COVID-19 accelerates the 4IR which influences higher education and how universities are prepared to face their challenges especially in Saudi Arabia during COVID-19 Pandemic and to run the learning and working process. The main question set by this study is "what are the implications of the fourth industrial revolution on higher education and how it contributes to the attainment of inclusive learning outcome and work productivity during the COVID-19 Pandemic". Regarding that, all the beneficiaries (students and member faculties) in Saudi universities from introducing digital systems of learning and work, have to commit to a lifetime of practising and updating their skills. The study aims to shed light on how 4IR maintains and strengthens the education system by using advanced technologies and digital learning systems. It focuses on how 4IR can keep, improve the learning outcome of students, enhance the capabilities of faculty members and their productivities in teaching and administrative work and ultimately, creating competently workplace environment in Saudi universities to deal with social distancing, quarantine, and isolation.

The paper contributes to the debate over the implications of the 4IR on higher education by assessing the impact of the COVID-19 pandemic in enhancing digital transformation in the education sector in Saudi Arabia in two principal ways. Firstly, most of the studies in the literature do not consider empirical analysis. Our paper then fills this gap by a survey method implementation for collecting data. A questionnaire distributed among a sample of two categories in some Saudi universities: faculty members and students. Five Likert Scale model used for the entire questionnaire statements, which designed to test the formulated hypothesis that states the introduction of technologies and digital learning systems. Supporting that the high education system compared to the traditional methods of the learning and administrative work can four main streams: (1) Better learning outcome for students (2) Enhanced faculty member's capabilities in teaching (3) Higher productivity of faculty members in administrative

tasks. (4) Creating an efficient work environment. Secondly, to our knowledge, no investigation for Saudi Arabia case study in previous research based on the 4IR on higher education considers both students and member faculties. Therefore, we set ourselves apart from the previous works in the literature on this subject in the empirical method and choice of the country. The rest of the paper is as follow literature review, methodology, data analysis, results, and conclusion.

Literature Review

The accurate effects of 4IR on higher education still not yet identified. However, the fact that they will bring reflective and quick evolutions seems to be certain. Considerable modernizations and transformations to program specifications should be required to allow students to develop capacity in the rapidly emerging areas of different sciences (Gleason, 2018). The idea is to promote high-equity-education and to build students' skills for learning to learn and lifelong learning (Organization for economic co-operation and development, 2008). Studies on digital learning come in response to the new school apprentice, increasing adult student population, and in the necessity of more technologically, practicality, accessibility, flexibility and cost educational effectiveness (Allen & Seaman, 2010; Nagel, 2010; Bates, 2011; David et al., 2012).

Technology is playing a big role in shaping the future of higher education. It is changing the classroom, the expanding role of online learning, global competition and the workforce, collaboration to extend corporate-university partnerships, and understanding challenges in renewing education. Technology continues to have a significant impact on higher education. In fact, technology will become a core differentiator in attracting students and corporate partners. Online learning is gaining a firm foothold in universities around the world. Two-thirds of academics responding say their institutions offer online courses. Corporate-academic partnerships will form an increasing part of the university experience. University respondents view technology as having a largely positive impact on their campuses but acknowledge operational challenges that hinder realizing full benefits. Higher education is responding to Globalization (Glenn, 2008).

The digital-learning environment allows educators and students to exchange ideas and information, work together on projects, around the clock, from anywhere in the world, using multiple communication modes. Effective course design begins by asking: what are the major learning goals and objectives for this course? Once these goals and objectives have been identified and clearly articulated, the question of which learning strategies, activities, and experiences to employ can be addressed. Much of the power of digital-learning lies in its capacity to support multiple modes of communication including any combination of student-student, student-faculty, faculty-student, faculty-faculty, student-others, others-students, etc. Taking into account the varied learning styles of learners and providing opportunities for self-directed and collaborative learning, educators can facilitate powerful, effective courses geared to achieve specific learning goals and outcomes using the vast resources and capacities of online learning. However, Paul, (2014) tests learning effectiveness by comparing three modes of teaching: face-to-face (classroom delivery), electronic learning (via electronic medium) and mobile learning (via smartphones, tablets and laptops). The author finds no significant difference among the three methods in learning effectiveness and concludes that it is necessary to consider other factors in measuring the effectiveness of training delivery method as cost and deployment time.

Saudi Arabia is the biggest information and technology market in the MENA Region. Spending per year reaches 45 billion dollars at the end of 2019. As well, education continues to receive the largest share of the government budget expenditure. Between 2014 and 2020, the government spent on education and training around SAR 200 billion/Year (General Authority for Statistics, 2020). As digital-learning continues its rapid growth in different educational institutions, there has been an increased study of strategies for its successful implementation (Aldiab et al., 2017; Aljaber, 2018; Al-Shehri, 2010; Alharbi & Litchfield, 2013). These include case studies describing effective practices for building, funding, and sustaining e- programs within the university. The COVID-19 pandemic hit the education sector like all

other sectors by surprise. The existence of a digital technology system already implemented by the ministry of higher education minimized the closing effects of universities and saved the academic year.

In addition, there is a growing research base on the delivery of effective online models that are scalable, improve learning, and lower cost. Throughout the research, there is an emphasis on the need for administrators to be strategic in their use of online learning, and to ensure that faculty are trained in its effective design and delivery. Aldiab et al., (2017) display the most important challenges in the Saudi educational system. Population is mainly concentrated in three principal provinces Makah, Riyadh and Eastern Provence and the distribution of campuses across different provinces is not uniform. Aljaber (2018) identified other challenges as the infrastructural factors that limit digital learning, including the technology gap, course design, student motivation and supervision. In the same vein Al-Shehri (2010) apply a qualitative analysis to examine current and future developments and challenges of digital - learning in Saudi Arabia and finds that digital -learning had come to stay, but acknowledged challenges in respect of resources, organization, management, and information technology. Alharbi and Litchfield (2013) shown that despite the importance and usefulness of digital learning, there is a lack of knowledge and skills. Most of the studies confirm that digital -learning can be a part of the solution by promoting digital -learning and distance education and insisting on providing a clear vision and strategic planning with prospective e-learners to make digital -learning programs cost-effective (Aldiab et al., 2017; Aljaber, 2018; Al-Shehri 2010; Alharbi and Litchfield 2013).

In this study, we assume that the 4IR has an explicit impact in shaping the learning and work systems in higher education to mitigate the consequences of the COVID-19 Pandemic, through introducing digital learning and advanced technological work systems. The study assumes that digital learning systems represent an efficient alternative of the traditional learning system compared to traditional learning in such circumstances. Also, distance work based on using technological systems, proves its effectiveness and validation helping in running the work requirements and tasks efficiently, regarding various administrative levels and so create an inclusive human development and work environment. As it is denoted by Ruona (2016) either learning or performance improvement, most of them incorporate the emphasis on learning and development in the workplace. The concept of digital learning in this study defined as any type of learning that is accompanied by technology or by instructional practise that makes effective use of technology. It encompasses the application of a wide spectrum of practices including blended and virtual learning. Similarly, the technological work systems, embodied in all technologies and automation of work systems used to run the work tasks and duties, keeping fluent and effective work continuity and productivity.

Methodology

Research design
To provide answers for the main question of this study, and to fulfil its objectives, a survey method is implemented. An electronic questionnaire distributed among a sample of 250 individuals consists of two categories:
- First: 125 Faculty members of different Saudi Universities.
- Second: 125 Students in some private and public Saudi Universities.

Five Likert Scale model is used for all the questionnaire statements which are designed to test the formulated hypothesis. The research hypothesis state that the introduced technologies and digital learning systems, strengthen the high education system compared to the traditional methods of learning and administrative work in four main streams:
- Better learning outcome for students
- Enhanced faculty member's capabilities in teaching and research
- Higher productivity of faculty members in administrative tasks.
- Creating an efficient work environment.

Research Procedure
A descriptive and inferential statistical analysis, using SPSS statistical Program, are applied to analyze the data and test the hypothesis. The following statistical methods are used:
1. Frequencies & Percentages: This is used for describing personal data for the study sample.
2. Cronbach's Alpha Factor: to estimate the reliability of the questionnaire questions, in this study, it is calculated for the whole questions of the survey, and for the questions in each section individually.
3. Mean: to identify to what extent the responses for statements and the main dimensions of the study.
4. Relative Importance Index: to measure the response related to the rating of each statement to determine the significance of the statement represented in the five Likert scale. (Kodiri, 2011).
5. Standard Deviation: shows how much variation or dispersion exists from the average (mean), or expected value, the more values came close to zero the more responses are centred and dispersion decreased.
6. One sample T-test: to determine whether the sample mean is statistically different from a known or hypothesized population mean.
7. Paired sample T-test results: To test the statistically significant differences between two means, it is a statistical procedure used to determine whether the mean difference between two sets of observations is zero. In the present study, it is used to measure the statistical significance of the difference between the mean of agreement score of the two categories (Faculty members &Students) towards the effectiveness of E-learning.

Data Collection Tools
Two questionnaires are designed to collect data, one for faculty members and the other for students. The faculty members' questionnaire consists of 2 parts: First is personal information and the second part is divided into 4 sections, each section contains some statements related to one of the study hypotheses. The total number of statements for all sections is 34. Five Likert Scale model for all statements scaled: 1. strongly disagree- 2. disagree- 3. neutral- 4. agree – 5. strongly agree.

The sections are as follows:
- Section 1: Digital Learning is distinct compared to Traditional Learning
- Section 2: Digital Learning improves the Students' learning outcomes
- Section 3: Digital Learning enhances Faculty Members Capabilities
- Section 4: Implementation of technical systems develops staff productivity and work environment

Similarly, the questionnaire of students consists of two parts, the first part is personal information and the second part is subdivided into two sections of overall 16 statements.

The sections are as follows:
- Section 1: Digital Learning distinct compared to Traditional Learning
- Section 2: Digital Learning improves Students' learning outcomes.

<center>**Data Analysis**</center>

Descriptive Analysis
A random sample of two categories (Faculty members and Students) with a total of 250 participants are used, each group 125 respondents. The survey is fairly distributed covering all regions in Saudi Arabia, but due to the time and resources limitations of the study, the survey covered some not all the public and private universities in Saudi Arabia. So, the response came as it is shown in tables1 and 2 below. The data of the sample variables are analyzed from the personal information part of the questionnaires.

Table 1. Faculty Members Sample Distribution

Variable	classification	Number	Total	Frequency %	Total
Gender	Male	32	125	25.6	100%
	Female	93		74.4	
Nationality	Saudi	29	125	23.2	100%
	Non- Saudi	96		76.8	
Age	25-35	21	125	16.8	100%
	36-45	64		51.2	
	46-55	33		26.4	
	More than 55	7		5.6	100%
University	Public	124	125	99.2	100%
	Private	1		0.8	
Region of the university	Central	49	125	39.2	100%
	Northern	51		40.8	
	Southern	12		9.6	
	Western	12		9.6	
	Eastern	1		0.8	
Major of the college	Scientific	66	125	52.8	100%
	Humanity	52		41.6	
	Health	2		1.6	
	Technical	5		4	
Occupation	Full Professor	4	125	3.2	100%
	Associate Professor	18		14.4	
	Assistant Professor	79		63.2	
	Lecturer	24		19.2	

The data of the faculty members sample shows that more than 70% of the respondents are female and the Non –Saudi constitutes about 78% of the total participants. The response from private universities faculty members is very low, hence semi total number of the respondents are from public universities. Respondents of universities in Northern and Central regions are respectively the highest compared to other regions in Saudi Arabia. More of half of the respondents are working in scientific colleges followed by humanity majors, and very little numbers are of technical and health majors. The respondents of Assistant Professor's occupation are the highest about 63% of all other faculty members' occupations and this may be consistent with the distribution of faculty member's occupations in higher education.

For the second category sample (students), table no. 2 shows that female participants represent about 90% of the sample, and about 77% are Saudi. The participants are mostly of age category 18-25 years, which is the age range of undergraduate students. Two third of the sample respondents are of public universities, and the majority of respondents are from universities located in Central and Southern regions of Saudi Arabia. More than 50% of the participants are of scientific majors, followed by Humanity majors. The students of Bachelor degree constitute more than 90% of the participants. This distribution may be compatible with the overall distribution of high education students in Saudi Arabia considering the academic levels.

Table 2. Students Sample Distribution

Variable	Classification	Number	Total	Frequency %	Total
Gender	Male	12	125	9.6	100%
	Female	113		90.4	
Nationality	Saudi	96	125	76.8	100%
	Non- Saudi	29		23.2	
Age	Less than 18	2	125	1.6	100%
	18-24	105		84	
	25-30	18		14.4	
University	Public	93	125	74.4	100%
	Private	32		25.6	
Region of the university	Central	55	125	44	100%
	Northern	14		11.2	
	Southern	31		25.6	
	Western	16		12.8	
	Eastern	8		6.4	
Major of the college	Scientific	73	125	58.4	100%
	Humanity	40		32	
	Health	8		6.4	
	Technical	4		3.2	
Academic Degree	Master	3	125	2.4	100%
	Bachelor	119		95.2	
	Diploma	3		2.4	

Validity and Reliability of the Survey

The face and content validity of the survey have been evaluated by 3 reviewers who confirmed the validity of the questionnaire to test the hypothesis of the study. Using the statistical Program (SPSS) version 26, Cronbach's Alpha factor has been calculated to test the reliability of the survey. It shows that reliability of the Faculty staff questionnaire is about 98%, and that of students is 93%. Both questionnaires are of high degree of reliability particularly that of the faculty members, referred to the standard (99%). In addition, Cronbach Alpha factor is calculated for the questions of each section separately to measure the internal consistency of the questions and its reliability to measure what it is designed to measure. The Cronbach alpha factor for the four sections of the questionnaire is above 90%, as it is shown in table no. 3 below. This indicates that the questions of the questionnaire are measuring what they are designed to measure and have a high level of validity and reliability.

Table 3. Cronbach Alpha Factor

Section	Sample	Cronbach Alpha Factor	Number of statements
First	First section Digital Learning is distinct compared to Traditional Learning	0.90	8
Second	Digital Learning improves the Students' learning outcomes	0.92	8
Third	Digital Learning enhances Faculty Members Capabilities	0.94	7
Fourth	Implementation of technical systems develops staff productivity and work environment	0.93	11
Faculty Members Questionnaire	All sections	0.975	34
Students Questionnaire	All sections	0.927	16

Inferential Analysis

Mean and One Sample T-test

The mean, standard deviation, relative importance index and one-sample t-test are calculated for each statement in the four sections of the faculty members' survey and the two sections of the students' survey. The mean shows that the scale of respondents' opinions about the statement, where 1 strongly disagrees to 5 strongly agrees. The overall mean for all the statements in the section is found to reveal the scale of the section. To get the relative importance for scores of the respondents, Relative Importance Index (RII) is calculated using the formula: {5n5+4n4+3n3+2n2+1n1/A*N} (Kodiri, 2011).

Table no. 4 shows the scale distribution of the RII for each level of the Likert scale. It is applied to measure the response related to the rating of each statement according to the answers of the respondents ranging from strongly disagree to strongly agree.
One sample t-test with two-tailed significance level 95% is calculated for all statements to test differences in the mean of each statement in the section on level of the agreement on the agree score.

Table 4. Relative Importance Index for Likert scale categories

Relative importance index	Scale
0.8≤ RII ≤ 1	Strongly Agree
0.6≤ RII ≤ 0.8	Agree
0.4≤ RII ≤ 0.6	Neutral
0.2≤ RII ≤ 0.4	Disagree
0 ≤ RII ≤ 0.2	Strongly disagree

Table 5. One sample T-test (Faculty members)
Section 1: Digital Learning is distinct compared to Traditional Learning

No.	Statements	df	Mean	RII	Scale	Standard Deviation	T value	Sig. (2-tailed)
1	Digital learning is more effective and efficient than traditional learning	124	3.8560	0.7712	Agree	0.97306	40.110	0.000
2	Provides intensive learning materials in different forms	124	4.0240	0.8048	Strongly agree	0.91108	59.386	0.000
3	Facilitates the learning process	124	4.1200	0.824	Strongly agree	0.79919	56.961	0.000
4	Offers more time flexibility	124	4.2560	0.8512	Strongly agree	0.80225	60.397	0.000
5	Improves learners capabilities to interact with digital society	124	4.0000	0.8	Strongly agree	0.95038	57.181	0.000
6	Enables learners to communicate with other learners on the web	124	4.1120	0.8224	Strongly agree	0.90888	57.961	0.000
7	Learners can get electronic learning resources with less cost	124	4.0000	0.8	Strongly agree	1.04727	58.286	0.000
8	Appropriate technical infrastructure is available	124	3.7840	0.7568	Agree	1.00470	53.087	0.000
	All statements		4.1580	0.8316	Strongly Agree			

The mean and RII for all the statements of this section which states that Digital learning is distinct compared to traditional learning is of scale Strongly Agree, and the mean for all statements is too of scale Strongly Agree, except the first and last statements which have the score agree. One sample T-test also indicates that all statements are significant; hence p-value is less than (0.05) with a confidence level of 95%. Therefore, this result can prove the hypothesis of the research that digital learning is distinct compared to traditional learning according to the faculty member's opinions.

Table 6. One sample T-test (Faculty members)
Section 2: Digital Learning improves the Students' learning outcomes

No.	Statements	df	Mean	RII	Scale	Standard Deviation	t - value	Sig. (2-tailed)
1	Digital learning enables students to use different technical learning strategies	124	4.1680	0.8336	Strongly Agree	0.73765	63.173	0.000
2	Students can acquire more knowledge on the course	124	4.2240	0.8448	Strongly Agree	0.73905	63.901	0.000
3	Enhances the students' technical and cognitive skills	124	4.2640	0.8528	Strongly Agree	0.73115	65.203	0.000
4	Facilitates practical applications of the course	124	4.2160	0.8432	Strongly Agree	0.76816	61.363	0.000
5	Electronic assessments and tests are easily done	124	4.3200	0.864	Strongly Agree	0.74704	64.654	0.000
6	Students can get immediately the evaluation of their performance on assessments	124	4.4320	0.8864	Strongly Agree	0.74418	66.585	0.000
7	Facilitates referring back to the lectures at any time	124	4.4480	0.8896	Strongly Agree	0.71229	69.817	0.000
8	Students can easily set their feedback and suggestions on the course	124	4.3120	0.8624	Strongly Agree	0.77684	62.058	0.000
	All Statements		4.2980	0.8596	Strongly Agree			

The second hypothesis of the study which implies that Digital Learning improves the Students' learning outcomes, is also valid according to the overall and individual mean and the RII of statements, which is of scale Strongly Agree. One sample t-test revealed the significance of all statements where the p-value is less than 0.05.

Table 7. One sample T-test (Faculty members FM)
Section 3: Digital Learning enhances Faculty Members Capabilities

No.	Statements	Df	Mean	RII	Scale	Standard Deviation	t-value	Sig. (2-tailed))
1	Digital learning strengthens the technological abilities of FM	124	4.2880	0.8576	Strongly Agree	0.73853	64.915	0.000
2	Enables FM to use time efficiently	124	4.2080	0.8416	Strongly Agree	0.80619	58.357	0.000
3	Offers more flexibility for FM to attend online courses	124	4.2560	0.8512	Strongly Agree	0.72850	65.317	0.000
4	Enables FM to communicate with other learners on learning platforms	124	4.1600	0.832	Strongly Agree	0.78699	59.099	0.000
5	Improves the research capabilities through research platforms and digital libraries	124	4.2800	0.856	Strongly Agree	0.83859	57.063	0.000
6	Keeps FM update with the recent developments in their fields	124	4.3040	0.8608	Strongly Agree	0.86345	55.730	0.000
7	Enhances FM productivity in providing educational services	124	4.2080	0.8416	Strongly Agree	0.79612	59.095	0.000
	All Statements		4.2434	0.848	Strongly Agree			

To test the second hypothesis of this research that digital learning enhances faculty members' capabilities, analysis shows that RII and the of all statements for this section is of scale Strongly Agree. This result is supported by t-test analysis which denotes the significance of all statements of the section, where the p-value is less than 0.05. Relying on this result, we can say that our hypothesis that digital learning enhances faculty members' capabilities is valid.

Table 8. One sample T-test (Faculty members)
Section 4: Implementation of technical systems develops staff productivity and work environment

No.	Statements	df	Mean	RII	Scale	Standard Deviation	t-value	Sig. (2-tailed)
1	Digital and technological systems facilitates the administrative procedures	124	4.328	0.8656	Strongly agree	0.7159	67.591	0.000
2	Provide more transparency in work	124	4.176	0.8352	Strongly agree	0.82368	56.683	0.000
3	Enhance technological skills of the staff	124	4.304	0.8608	Strongly agree	0.79539	60.499	0.000
4	Accelerate the transactions and save time	124	4.352	0.8704	Strongly agree	0.69857	69.652	0.000
5	Facilitate the transactions among various units in the university	124	4.344	0.8688	Strongly agree	0.74166	65.484	0.000
6	Offer more efficiency in utilization of the university resources	124	4.264	0.8528	Strongly agree	0.75289	63.32	0.000
7	Reduce the direct communication among staff	124	4.344	0.8688	Strongly agree	0.68514	70.887	0.000
8	Provide comprehensive data base of all university's resources	124	4.368	0.8736	Strongly agree	0.69021	70.755	0.000
9	Enable administrative leaders to focus on strategic and development aspects	124	4.24	0.848	Strongly agree	0.79717	59.466	0.000
10	Link the university with other related institutions in the industry	124	4.24	0.848	Strongly agree	0.7229	65.576	0.000
11	The university provides appropriate technical infrastructure	124	4.176	0.8352	Strongly agree	0.75203	62.084	0.000
	All statements		4.2850	0.8570	Strongly agree			

Similar to the previous sections, the mean of all statements and the overall mean concerning the fourth hypothesis that Implementation of technical systems develops staff productivity and work environment comes of scale Strongly Agree. The one-sample t-test indicates the significance of all statements where p-value is less than 0.05. Therefore, we can prove the validity of the hypothesis that Implementation of technical systems develops staff productivity and work environment in Saudi Universities according to Faculty members' opinions.

Table 9. One sample T-test (Students)
Section 1: Digital Learning is distinct compared to traditional learning

No.	Statements	df	Mean	RII	Scale	Standard Deviation	T-value	Sig. (2-tailed)
1	Digital learning is more effective and efficient than traditional learning	124	3.8560	0.7712	Agree	0.97306	44.305	0.000
2	Provides intensive learning materials in different forms	124	4.0240	0.8048	Strongly agree	0.91108	49.381	0.000
3	Facilitates the learning process	124	4.1200	0.824	Strongly agree	0.79919	57.637	0.000
4	More time flexibility	124	4.2560	0.8512	Strongly agree	0.80225	59.312	0.000
5	Improves learners capabilities to interact with digital society	124	4.0000	0.8	Strongly agree	0.95038	47.056	0.000
6	Enable learners to communicate with other learners on the web	124	4.1120	0.8224	Strongly agree	0.90888	50.583	0.000
7	Learners can get electronic learning resources with less cost	124	4.0000	0.8	Strongly agree	1.04727	42.703	0.000
8	Appropriate technical infrastructure is available	124	3.7840	0.7568	Agree	1.00470	42.109	0.000
	All Statements		4.0190	0.8038	Strongly agree			

Analysis of student's survey for the section of (Digital Learning is distinct compared to traditional learning) shows that the mean and RII of all statements are of scale Strongly Agree, except the last statement is of scale Agree. The overall mean and RII of statements is of scale strongly Agree, and t-test analysis indicates the validity of the hypothesis which says that digital learning is distinct compared to traditional learning, hence p-value of all statements is less than 0.05.

The analysis of results of faculty members and student's surveys concerning this section shows that both categories believe that digital learning is better and distinct compared to traditional learning. These results put higher education in Saudi Arabia in a challenge for providing appropriate circumstances and technical infrastructure, which enables universities to enlarge and adopt more digital learning systems.

Table 10. One sample T-test (Students)
Section 2: Digital Learning improves the Students' learning outcomes

No.	Statements	df	Mean	RII	Scale	Standard Deviation	t - value	Sig. (2-tailed)
1	Digital learning enables students to use different technical learning strategies	124	4.1520	0.8304	Strongly agree	0.71905	64.559	0.000
2	Students can acquire more knowledge on the course	124	4.1040	0.8208	Strongly agree	0.76014	60.363	0.000
3	Enhances the students' technical and cognitive skills	124	4.0080	0.8016	Strongly agree	0.82790	54.126	0.000
4	Facilitates practical applications of the course	124	4.1440	0.8288	Strongly agree	0.85858	53.963	0.000
5	Electronic assessments and tests are easily done	124	4.3200	0.864	Strongly agree	0.74704	64.654	0.000
6	Students can get immediately the evaluation of their performance on assessments	124	4.2560	0.8512	Strongly agree	0.82211	57.879	0.000
7	Facilitates referring back to the lectures at any time	124	4.1520	0.8304	Strongly agree	0.86188	53.860	0.000
8	Students can easily set their feedback and suggestions on the course	124	4.1600	0.832	Strongly agree	0.87437	53.193	0.000
	All Statements		4.1620	0.8324				

This section is validated by the mean, RII and one sample t-test analysis, however, the mean and RII for all statements of the section are of scale Strongly Agree. One sample t-test shows the significance of all statements which is less than 0.05. So, the analysis results of both faculty members and Students surveys indicate accepting the hypothesis that Digital Learning improves the Students' learning outcomes.

Paired Sample T- test

Table 11. Paired Sample T-Test (Faculty Members & Students)
Digital Learning is distinct compared to traditional learning

No.	Statements	DF.	Mean	Standard Deviation	T - value	Sig. (2-tailed)
1	Digital learning is more effective and efficient than traditional learning	124	0.02400	1.37644	0.195	0.846
2	Provides intensive learning materials in different forms	124	0.22400	1.16303	2.153	0.033
3	Facilitates the learning process	124	0.08800	1.12175	0.877	0.382
4	More time flexibility	124	0.08000	1.11876	0.799	0.426
5	Improves learners capabilities to interact with digital society	124	0.14400	1.30572	1.233	0.220
6	Enable learners to communicate with other learners on the web	124	0.72000	1.21267	0.664	0.508
7	Learners can get electronic learning resources with less cost	124	0.31200	1.42227	2.453	0.160
8	Appropriate technical infrastructure is available	124	0.21600	1.33552	1.808	0.073
	All statements	124	0.13900	1.25702	1.224	0.313

Results of the Paired sample t-test shows that there is no statistical significance difference between the mean of the two groups; Faculty members and students about the hypothesis that digital learning is distinct compared to traditional learning. Hence, the p-value for all the section statements is 0.313> 0.05 with two significances level 95%. Also for each of the statements except the second statement p-value is greater than 0.05. So, according to this result, we can say that both faculty members and students agree that digital learning is distinct compared to traditional learning, except for the statement of provides intensive learning materials in different forms, where p-value equals 0.03> o.05.

Analysis of the paired sample t-test for the hypothesis; (Digital learning improves the students' learning outcomes), shows that there is no statistical significance difference between the mean of the two groups faculty members and students, where p-value for all statements of the section is 0.62>0.05 with two significances level 95%. All statements of the section have no significant difference between the means of the two groups, except for two statements: (1) Enhances the students' technical and cognitive skills & (2) Facilitates referring back to the lectures at any time. The p values of these statements are respectively 0.03 and 0.005 >0.005 which indicates that there are significant differences between the means of the faculty members and the students.

Table 12. Paired sample T-Test (Faculty Members and Students)
Digital Learning improves the Students' learning outcomes

No.	Statements	Df.	Mean	Standard Deviation	t - value	Sig. (2-tailed)
1	Digital learning enables students to use different technical learning strategies	124	0.01600	1.03163	0.173	0.863
2	Students can acquire more knowledge on the course	124	0.12000	1.07463	1.248	0.214
3	Enhances the students' technical and cognitive skills	124	0.25600	1.13524	2.521	0.013
4	Facilitates practical applications of the course	124	0.07200	1.14424	0.704	0.483
5	Electronic assessments and tests are easily done	124	0.00000	1.06256	0.000	1.000
6	Students can get immediately the evaluation of their performance on assessments	124	0.17600	1.16442	1.690	0.094
7	Facilitates referring back to the lectures at any time	124	0.29600	1.15719	2.860	0.005
8	Students can easily set their feedback and suggestions on the course	124	0.15200	1.10757	1.534	0.127
	All statements	124	0.13600	1.10968	1.341	0.621

Discussion

COVID-19 circumstances represented a challenging time for higher education and interrupted the higher education all over the globe, as it is mentioned by the study Bozkurt et al. (2020), this study finding showed that digital learning is distinct to traditional learning and brings better learning outcome for students in Saudi higher education. The availability of strong digital infrastructure and learning system contributed to this overwhelming success of digital learning in these hard times of COVID-19. Both students and faculty members were subjected to intensive training courses on using digital learning systems, this assisted in easy adoption of the new digital systems of education and facilitated the educational and assessment procedures. Success in the transformation to complete digital learning in a very short time and generating positive learning outcomes for students as it is revealed by the results of the study are partially compatible with the findings of Aldiab et al., 2017; Aljaber, 2018; Al-Shehri 2010; Alharbi and Litchfield 2013, which confirmed that digital -learning can be a part of the solution by promoting digital -learning and distance. Similarly, Samar et al. (2020) which stated that distance learning provides a good environment for most students, however students with financial challenges and special needs may not have equal chances to access technology.

The findings of the study denoted to the significance of the hypothesis that digital learning improves the capabilities of the faculty members. However, flexibility in time and availability of intensive online courses played a catalyst factor in enhancing the skills and performance of the faculty members. The adoption

of digital learning during the emerging times of COVID-19, provided a good opportunity for instructors to practice on digital learning and teaching. These results are somehow not agreed with what is mentioned by Charles el al., (2020), that turning to e-learning requires planning, preparation, and development time for a fully online university course is six to nine months before the course is delivered. Faculty are usually more comfortable teaching online by the second or third iteration of their online courses. It will be impossible for every faculty member to suddenly become an expert in online teaching and learning in this current situation, in which lead times range from a single day to a few weeks.

The results showed significance of the hypothesis that technological changes improve the productivity of the staff and develop the work environment. However, the implementation of new technologies and digital work systems, contribute effectively to productivity of human capital and to the work environment. These results are consistent with the findings of Hiyam, (2017) of a study carried on University staff in Saudi Arabia, which revealed that technological system of work has significant impact on improving human capital productivity through enhancing the abilities of workers.

Conclusion and Suggestions

This study discussed the effectiveness of the digital transformation that resulted in the 4IR on higher education institutions in Saudi Arabia. However, Saudi universities implemented digital learning and advanced technical systems of work as the main mode of learning and work to face the consequences of COVID-19 pandemic. The findings of the study based on the statistical tests; mean, RII, one sample t-test and paired sample t-test, proved all the hypothesizes of the study; that digital learning is distinct compared to traditional learning, it improves the learning outcome of students and that technological work systems improves the productivity and develop the work environment. One of the limitations of this study, that the majority of students and faculty staff who responded to the survey are of humanities and science majors, while health major is very few. Therefore, these results may not be generalized to health and other similar majors, which requires laboratory mode of learning, as it is mentioned with Samar, et al. (2020), that cognitive, communication and clinical skills are best achieved in traditional learning. According to these results, authors suggest that further empirical studies carried on the challenges and obstacles, which confront the digital learning and how to maximize its benefits. Also, the authors suggest to carry out specialized studies on the effectiveness of implementing technical systems of work in achieving the targeted human development and high efficient work environment.

Finally, as mentioned in Bozkurt and Sharma (2020) that the world is moving, and the education interruptions are multiples and not limited to pandemics. Emergency remote teaching should cooperate with diverse other actors like psychologists, sociologists, therapists to provide the best resolutions as students and teachers will keep in mind how they felt during these hard periods and not the learning content delivered.

Acknowledgments

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