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The Effect of distance learning on scientific thinking skills among students of the College of Education at the University of Jordan amidst the outbreak of COVID-19

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Abstract

This study aimed to know the effect of distance learning on scientific thinking skills of students enrolled in the College of Education at the University of Jordan during the outbreak of the Corona virus in Jordan. The study sample included (369) male and female students from the College of Education who are registered in the first semester of the academic year 2021/2022 at the University of Jordan. They were chosen by simple random method. To achieve the objectives of the study, the correlative descriptive approach along with This study aimed to know the effect of distance learning on scientific thinking skills among students of the College of Education at the University of Jordan during the spread of the Corona virus in Jordan. The study sample consisted of (369) male and female students from the College of Education who are registered in the first semester of the academic year 2021/2022 at the University of Jordan. They were chosen by simple random method. To achieve the objectives of the study, the correlative descriptive approach along with the Scientific Thinking Skills Scale were used. The validity and reliability of the scale were verified and then applied to the study sample.

The results of the study reflected that the students' thinking skills recorded a low degree. Moreover, the degrees of skills tool the following order: (the skill of defining the problem, the skill of testing the validity of the hypothesis, the skill of setting hypotheses, the skill of interpretation, and in the last place came the skill of generalization). The results also indicated that there were no statistically significant differences at the level ($\alpha = 0.05$) between individuals' responses to each of the skills (defining the problem, testing the validity of the hypothesis, generalization) due to the difference in the gender variable and the different years of study.

Keywords: Scientific thinking skills, distance learning, problem identification, hypothesis testing, hypothesis development, interpretation, generalization.

Introduction:

The world is currently witnessing a knowledge, scientific and technological revolution in various fields, and this knowledge revolution is not limited to just one field, but rather included all sectors, especially the educational sector, which is the main pillar upon which peoples' culture, development and advancement are structured. The use of modern technology has become a feature of this era. In this context, educational institutions hastened the development of their educational systems to keep pace with this change and the rapid and successive development in technologies and its attendant repercussions on the educational process that is always influenced by any change in society and influences it in return. This successive rapid development of technology makes those interested in the educational process in constant need to search for new educational methods that suit the features of development, including distance education (Valentine, 2002).

Today, distance education has become dependent on modern technology such as

computers, tablets and smart phones. We also have the means of distance education which provide direct communication between the teacher and the learner at the same time, and includes telephone communications, social media and the means of distance education, which are available to individuals everywhere, regardless of time, and they are what websites specialized in distance learning use, such as videos that the teachers record and then the students watch in their spare time or correspondence via the Internet (Omira, Tarshon, Alyan, 2019).

It is known that by the end of the year (2019), the world faced a catastrophe caused by the outbreak of the Corona virus infection (COVID-19). Based on the rapid and successive effects that have occurred on societal institutions in general and educational institutions in particular as a result of the outbreak of this pandemic, a new vision must be adopted in the management of disasters in these institutions by preparing training programs to deal with such an emergency disaster so that these programs are structured through a necessary information system, which must be available at the level of educational institutions and their departments (Mahros, 2020).

The Corona virus crisis has led to the closure of thousands of schools and universities around the world, and thus many educational institutions in several Arab countries have resorted to the option of distance education. This procedure comes as a necessity to continue teaching the prescribed curricula and to fill any educational gap that may result from the aggravation of the crisis. In Jordan, which was not free from the virus and its impact on society, specialists developed a tight crisis plan to reduce the spread of the Corona virus in educational institutions and it's consequences that may disrupt students from their studies. The plan aimed to guarantee students' right to education during the exceptional circumstances the Kingdom is going through. And based on the measures taken by the state to contain the outbreak of the Corona virus and prevent its spread, the government of Jordan has adopted an integrated plan for distance education (Miqdadi, 2020).

Al-Khatib (2020) explained that this crisis cast a shadow over the educational sector, which prompted educational institutions to close their doors in order to curb the spread of the virus, and then those institutions turned to e-learning as an alternative that had long been controversy over the necessity of integrating it into the educational process, especially after knowing the fact that this process was directly affected by the industrial revolution and the development of "Artificial Intelligence" and "Internet of Things" technology, as well as the information technology revolution that invaded most forms of human life and became an integral part of it. Therefore, the researchers decided to conduct this study due to its theoretical and practical importance.

The theoretical importance of this study is represented in the scarcity of studies that focused on the subject of the study – as per the researchers' knowledge – in light of the emerging conditions. Although many studies and field research that dealt with the distance learning variable and scientific thinking skills were conducted, there were no studies that dealt with the impact of distance learning on the scientific thinking skills of University of Jordan students during the spread of the Corona virus. Hence the need for such a study emerged. It aims to draw attention to the scientific thinking skills of the students of the University of Jordan in the light of distance learning and to stand to support this stage in addition to providing feedback for the benefit of the education directorates, as well as helping and motivating students to apply self-education and development of scientific thinking skills on an ongoing basis.

As for the importance of this study from an applied point of view, it is represented in the researchers' desire to reveal the effect of distance learning on the scientific thinking skills of students of the College of Education at the University of Jordan during the spread of the Corona virus. This may help researchers in preparing field studies concerned with other problems with the possibility that institutions benefit educational programs as well as counselors and specialists who deal with this category of standards that were developed in this study. This study may open the way for researchers to conduct similar studies dealing with different samples and stages in the Hashemite Kingdom of Jordan. In this context, it was noted that there is a lack of studies examining the variables of the current study, and therefore there is a need to conduct studies that address such variables.

Problem and questions of the study:

Any observer of the conditions of the educational systems through the different ages recognizes that education was not immune to the surrounding societal conditions. It has always been affected by the social, health, economic and political events and changes taking place in the society. In view of the current conditions and the spread of the Corona virus in the countries of the world and due to the presence and spread of the virus in Jordan, it was decided to suspend public and private universities in Jordan. In order to keep the education process going, the Ministry has implemented the distance education system in order to maintain the permanence and continuity of learning, which is a suitable learning method for this period, as students learn remotely at any time. This was confirmed by the study (Oketch, 2021), which indicated the success of the rapid transition to online learning during the emerging crisis of the Corona pandemic.

On the other hand, the results of (Alipio, 2020) indicated the ineffectiveness of the distance learning system due to the difficulty of some students' access to the Internet. This prompted the researchers to feel the importance of conducting this study. The problem of the study lies in answering the following main question:

What is the effect of distance learning on the scientific thinking skills of students of the College of Education at the University of Jordan during the spread of the Corona virus?

The problem of the study is to answer the following questions:

The first question: What is the level of scientific thinking skills among students of the College of Education at the University of Jordan during the spread of the Corona virus?

The second question: Are there statistically significant differences at (a = 0.05) in the level of scientific thinking skills among students of the College of Education at the University of Jordan according to the variable of gender and years of study?

Objectives of the study:

1) Revealing the level of scientific thinking skills among students of the College of Education at the University of Jordan in light of the Corona crisis and its consequences.

2) Finding out whether there are statistically significant differences at the level (α = 0.05) in the level of scientific thinking skills among students of the College of Education at the University of Jordan during the spread of the Corona virus, according to the variables of gender and years of study.

First: The theoretical framework:

Distance learning:

The system of distance education through information networks depends on the concept of the general approach, which includes a set of educational curricula in a system called the open access model, so that this system allows the development of curricula in an electronic form and the learner can access them, choose and compare between them. It is defined as "an organizational and emerging process that satisfies the needs of learners through their interaction with the educational experiences provided to them in unconventional ways that depend on their own capabilities, through the use of multimedia technology without being restricted to a specific time or place and without directly relying on the teacher" (Al-Hunaiti, 2004); (Kim, & Frick, 2011).

It is also defined as a type of education in which the student is isolated from his teacher and, at any time, he can use technological media, television channels and electronic platforms that include all educational curricula and school stages, which were prepared by the Jordanian Ministry of Education to continue the educational process in light of the Corona crisis and its consequences.

Distance learning began in the nineteenth century in 1840, and it was known as correspondence education. Its goal was to gain profit, as educational institutions design the educational contents necessary for non-traditional methods of learning to meet the learning desire of groups of society that are unable to attend classes required by traditional education (Al-Khatib, 2020).

At that time, educational content was sent by mail and consisted of (generally printed materials, study guides, written articles and other tasks and functions). Then the idea of open education emerged when the Open University was established in the United Kingdom in 1963, and it was then called the University of Air (Hartnett, St George, & Dron, 2011). Distance education today relies on the principle of direct communication via satellite to communication devices, receivers and the Internet, through which distance education programs have flourished significantly recently. Distance education is based on self-education, so the learner obtains

what he wants from the information and learns in the appropriate way (Schneider & Council, 2021). It also depends on the freedom of choice, especially in front of the various alternatives offered by distance education so that the teacher and the learner alike have the freedom to complete the educational process and achieve its ultimate goal. It is also based on the diversity of methods as modern technology, in designing networks and virtual sites, allows the teacher to use many methods of presentation (Soham, 2005).

The characteristics of distance learning are to provide a quick and secure delivery of educational media to the individuals concerned with learning, using multiple communication media based on printed, audio and visual materials and other advanced technological media. The students can access information and databases on the World Wide Web, talk with their colleagues live, and participate in dialogue or discussion groups. Distance learning also distances the learner and the teacher in the teaching process in terms of time and space, or both, which leads to the liberation of learners from the constraints of space and time compared to traditional educational systems.

One of the characteristics of distance education is also the presence of an educational institution responsible for the process of teaching and distance learning that supervises the planning of programs, preparation of educational materials, evaluation and follow-up processes, as well as the presence of two-way communication between the educational institution and the learner to help him take advantage of the programs or enter into a dialogue with the teacher and his fellow students (Cicha, Rizun, Rutecka, & Strzelecki, 2021).

The distance learning has gone through four generations: the messaging system, printed materials and audio-visual aids, the educational television and radio system, recorded and live lectures on satellite and radio stations, the multimedia system, audio, image, video, text and computerized materials, and systems based on the Internet and equipped with multimedia, with the possibility of interaction between the teacher and the student, such as interactive platforms, and audio-visual communication applications such as Microsoft Team (Al-Hunaiti, 2004).

Scientific thinking skills:

It is the ability to employ the products of education for knowledge and experience to apply them in solving real life problems to meet the goal (Zimmerman, 2007). It can be defined as the degree of response to the tool prepared for the study. The concept of scientific thinking refers to thinking about the content of science and the set of logical processes that permeate it, such as deduction, experimental design, causal inference, concept formation, hypothesis testing, and other processes that seek to find a solution to a specific problem (Saleh, 2013).

The concept of scientific thinking is not limited to a set of mental processes related to scientific content such as physics or engaging in scientific activities such as designing experiments, but also includes many cognitive processes related to general areas in human life such as areas of research, deduction, measurement, and other problem-solving processes and thinking about the reasons behind a problem. Also, scientific thinking is a social phenomenon that is affected by the factors, variables, and societal framework in which the problem appeared, and not just a mental activity that occurs without a reason (Al-Saadi, 2019).

Scientific thinking is characterized by a number of characteristics, the most important of which are cumulation, as each researcher adds what he has reached through scientific thinking, which leads to the accumulation of knowledge and organization, as the process of developing and testing hypotheses takes place in an organized and accurate manner to ensure the effectiveness of the results, and the search for reasons, as science is not limited to collecting information and the conclusion of facts about a phenomenon only, but also to the explanation of the reasons for its occurrence, comprehensiveness and certainty, as the goal of scientific thinking is to reach general results and solutions that can be resorted to in several other situations, accuracy and abstraction, in the sense that the language used by the researcher is a mathematical language based on scientific foundations to ensure accuracy and validity of results (Orion & Kali, 2005).

Scientific thinking is carried out through several organized steps, namely: realizing the problem, which would stimulate research and ask questions, since the existence of the problem is the only motivation to find a solution to it, defining and formulating the

problem in order to limit it and facilitate discussion of all aspects related to it. Collecting data and information, as every evidence related to the problem is important in order to reach a scientific conclusion about the problem in all its aspects. Making hypotheses to solve a problem, which include all guesses and possible measurable solutions to show whether they are correct or not. Hypotheses testing which means using appropriate scientific methods to reach an ideal solution to a problem. Conclusions and generalizations, which are the selection of the most appropriate hypothesis within the group of hypotheses that constitute a solution to a problem. Application and reuse, after finding a solution to the problem, new events and phenomena are predicted and the solution is reused in the best ways (Ahmed, 2021).

It also applies scientific thinking in all scientific, practical and human fields, including social sciences, commerce, law, journalism, and others. Scientific thinking is an ideal universal model of thinking, regardless of the type of specialization. That is, if a person possesses the skills of scientific thinking and the ability to criticize, elicit, analyze, develop and test hypotheses to reach results and solutions in a certain field, he will project this way of thinking to other areas in his scientific and practical life (Orion & Kali, 2005).

The importance of scientific thinking is reflected in the fact that the results of scientific thinking are conclusive evidence that can be relied upon and referred to when needed. Scientific thinking is positively reflected on individuals in terms of enhancing their capabilities in the areas of asking accurate questions, searching for useful scientific problems, formulating them accurately and clearly, collecting relevant data and information, and evaluating them using abstract ideas to reach effective interpretations, arrive at logical results and solutions and test them within appropriate standards, and accept other ideas and knowledge, with the largest number of hypotheses, their consequences, their practical effects, their evaluation and effective communication with others to reach the most appropriate solution when facing any problem (Siraj, 2021).

The individual can use scientific thinking to solve the problems he faces by developing questions and hypotheses and testing their validity. Among the challenges to scientific thinking, there are some determinants that impede scientific thinking, including adherence to myths and superstitions. Despite the development that science has achieved in the twentieth century, many are still clinging to some behaviors resulting from belief in illusory ideas and myths that have no basis and are far from scientific foundations. This would impede scientific thinking based on accurate analysis and realistic results (Al-Qaran, 2011).

Submissiveness also hinders scientific thinking. Individuals tend to support ideas and evidence that correspond to their desires, make them feel safe, or are consistent with the beliefs of their ancestors that they inherited for many years. Ideas based on sound scientific foundations weaken because of submission to the authority of seniority, fame, or spread. And also intolerance, as the intolerance that monopolizes any idea that has not been proven true and rejects any opinion that would reach the truth and contradicts the basic goal of scientific thinking, which calls for studying the largest number of hypotheses and generalizations, no matter how different and contradictory they seem to each other, to reach a solution to the problem and accept any change that may occur due to circumstances and changes (Al-Saadi, 2019).

Methodology:

The current study was limited to a sample of students of the College of Education at the University of Jordan, and was carried out in the first semester of the academic year 2021/2022. To achieve the objectives of the study, the descriptive analytical approach was used for its suitability to the nature of this study, with the aim of analyzing the data and arriving at results that help explain and answer the study questions.

The study population and its sample:

The study population included all students of the College of Education at the University of Jordan, who were approximately (3500) male and female students in the first semester of the academic year 2021/2022. The study sample was selected in a simple random way, amounting to (369) male and female students, and the test was distributed electronically to all of them, due to the repercussions of the emerging Corona crisis, and the inability to reach all members of society.

Table (1): The distribution of study members according to study variables.

Study variables	Categories	Frequencies	Percentage
Gender	Male	109	29.5%
	Female	260	70.5%
	Total	369	100.0%
Year of study	First	28	7.6%
	Second	94	25.5%
	Third	159	43.1%
	Fourth	88	23.8%
	Total	369	100.0%

The study tool:

After referring to the theoretical background and previous studies, the Scientific Thinking Skills Scale (Al-Masaeed, 2011) was used in order to measure the level of scientific thinking skills among University of Jordan students during the spread of the Corona virus. The tool of the study may consist of two parts: The first part includes demographic information, and it consists of: gender and school year. The second part: includes the study questions, consisting of (32) paragraphs, distributed on the following scientific thinking skills:

Stating the problem, and it includes paragraphs (1-8).

- Setting hypotheses, and it includes paragraphs (9-14).
- Testing the validity of the hypothesis, and it includes paragraphs from (15-20).
- Interpretation, and it includes paragraphs from (21-26).
- Circular, and includes paragraphs from (27-32).

The paragraphs on this tool are of the multiple choice type, and the test is corrected by giving one mark for the correct answer for the paragraph, and zero for the wrong answer, and thus the highest score that the respondent can obtain is (32), and the lowest score will be zero, with a hypothetical average (16) Degree .

The validity of the study tool:

To verify the validity of the apparent content of the study tool, it was presented in its initial form to a group of specialists in the faculties of educational sciences in Jordanian universities, in order to identify the suitability of the paragraphs to the scale, the soundness of their formulation, and the clarity of their meanings from the linguistic point of view. All the arbitrators' observations were taken into consideration and the linguistic restructuring was made to the paragraphs that were agreed upon by the percentage of (80%) of the arbitrators as a criterion for judging their validity.

Reliability of the study tool:

To verify the reliability of the study tool, a reliability coefficient was found for each of the fields and for the tool as a whole by applying the tool to a sample of (30) male and female students from outside the study sample and calculating the internal consistency coefficient for the paragraphs using the Cronbach-Alpha equation, which measures the extent of consistency In the answers of the study sample members to the paragraphs in the tool. Table (2) shows the values of the internal consistency coefficients for all paragraphs of the study tool:

Table (2) Internal consistency coefficients using Cronbach's alpha equation

#	Fields	Crunbach alpha	Paragraphs no.
1	Defining the problem	0.886	8
2	Making hypotheses	0.861	6
3	Hypothesis validity testing	0.879	6
4	Interpretation	0.852	6
5	Generalization	0.811	6
	Total scale	0.901	32

Table (2) shows the values of reliability coefficients for the study tool paragraphs according to Cronbach's alpha method. The values of the reliability coefficients of the paragraphs ranged between (0.811 - 0.886), while the value of Cronbach's alpha reliability coefficients on the paragraphs as a whole were (0.901). Difficulty and discrimination coefficients for the tool paragraphs: To verify the psychometric properties of the tool items, the difficulty and discrimination coefficients were extracted for each item of the tool, and the values of the difficulty and discrimination coefficients were as shown in Table (3).

Table (3) Difficulty coefficients and discrimination coefficients for each paragraph of the tool.

Paragraph no.	Difficulty factor	Discrimination factor	Paragraph no.	Difficulty factor	Discrimination factor	Paragraph no.	Difficulty factor	Discrimination factor
1	0.37	0.49	12	0.37	0.69	23	0.47	0.50
2	0.54	0.60	13	0.62	0.63	24	0.40	0.67
3	0.53	0.55	14	0.35	0.45	25	0.43	0.60
4	0.50	0.53	15	0.66	0.45	26	0.57	0.75
5	0.37	0.44	16	0.41	0.53	27	0.65	0.41
6	0.39	0.43	17	0.60	0.65	28	0.55	0.69
7	0.37	0.41	18	0.51	0.78	29	0.37	0.46
8	0.57	0.65	19	0.55	0.75	30	0.50	0.47
9	0.40	0.57	20	0.49	0.67	31	0.47	0.76
10	0.43	0.51	21	0.46	0.57	32	0.43	0.55
11	0.43	0.48	22	0.53	0.62			

Table (3) shows the values of the difficulty coefficients and the discrimination coefficients for each paragraph related to the semantic memory test after applying it to the exploratory sample. The values of the paragraphs' difficulty coefficients ranged between (0.35 - 0.66), while the values of the paragraphs' discrimination coefficients ranged between (0.41 - 0.76). These values are acceptable considering that the paragraphs of the tool have appropriate degrees of difficulty and discrimination.

Statistical processing:

Statistical treatments of the study data were carried out using the Statistical Package for Social Sciences (SPSS), as follows: The arithmetic means of the level of scientific thinking skills among students of the University of Jordan were extracted during the spread of the Corona virus. The two-way multivariate analysis of variance test (2 Way MANOVA) was used to test the average responses of the study sample in the level of scientific thinking skills among University of Jordan students according to the variables of gender and years of study.

The Cronbach-Alpha equation was used to find the internal consistency coefficient and ensure the reliability of the study tool. Moreover, the Pearson correlation coefficient was used to find the internal consistency validity coefficient of the study tool.

Results:

First: The results related to the first question:

What is the level of scientific thinking skills among University of Jordan students during the spread of the Corona virus? To answer this question, the values of each of the arithmetic means, standard deviations, estimation and ranks were calculated for the level of scientific thinking skills among students of the College of Education at the University of Jordan during the spread of the Corona virus in general, and for each of the skills. Table (4) shows the results:

Table (4): Arithmetic means and standard deviations of the level of scientific thinking skills among students of the College of Education at the University of Jordan during the spread of the Corona virus, and each skill is ranked in descending order.

No	Skills	Arithmetic mean	Standard deviation	rank	Level
.1	Defining the problem	3.06	1.40	1	Low
.3	Hypothesis validity testing	2.50	1.25	2	Low
.2	Making hypotheses	2.31	1.34	3	Low
.4	**Interpretation**	2.30	1.29	4	Low
.5	Generalization	2.23	1.30	5	Low
Total arithmetic mean		12.40	3.62		Low

Table No. (4) shows that the scientific thinking skills of students of the College of Education at the University of Jordan during the spread of the Corona virus recorded a low level, with an arithmetic mean (12.40) and a standard deviation (3.62). This mean is considered low relative to the hypothetical mean of (16). On the other hand, the scientific thinking skills of the students of the College of Education at the University of Jordan were as follows: The "problem identification" skill came in the first place with an arithmetic mean (3.06) and a standard deviation (1.40), and at a low level. In the second place came the skill of "testing the validity of the hypothesis" with an arithmetic mean (2.50) and a standard deviation (1.25), and at a low level. In the third place came the skill of "making hypotheses" with an arithmetic mean (2.31) and a standard deviation (1.34), and at a low level. And in the fourth place came the skill of "interpretation" with an arithmetic mean (2.30) and a standard deviation (1.29), and at a low level. In the last place, the skill of "generalization" came with an arithmetic mean (2.23) and a standard deviation (1.30), and at a low level. The researchers attribute this result to the sudden transition due to the spread of the pandemic, and this matter imposed on students new instructions in learning which brought about the transition to distance learning. Due to the fact that this experiment is new to the learning system in Jordan, students were not able to develop solutions commensurate with distance learning, along with the fact that there are many areas that lack internet services, and some of the services are very weak and they do not provide awareness and educational courses for university students in developing thinking skills and how to deal with distance learning, in addition to the special case of the College of Education, as its students, like other students of humanities, do not have an adequate level in dealing with applications of E-learning.

The theoretical background has indicated that scientific thinking is a social phenomenon that is affected by the factors, variables and societal framework in which the problem appeared, and not just a mental activity that occurs without a reason. The results of this study are consistent with the results of (Al-Mutairi, 2021), which indicated that there are great challenges for students in light of the spread of the Corona pandemic and the transition to distance learning. And it differs with the results of (Al-Juhani, 2021), which indicated that the level of self-learning and distance learning came to a high degree. The results also indicated a positive relationship between self-learning and distance learning in light of the Corona pandemic. In this context, the results of this study agree with (Miqdadi, 2020), whose results concluded that there is a positive effect of using distance education in light of the emerging Corona crisis.

Second: To answer the second question, "Are there statistically significant differences at the significance level ($\alpha = 0.05$) in the level of scientific thinking skills among students of the College of Education at the University of Jordan according to the variables of gender and years of study?", arithmetic means and standard deviations of the level of scientific thinking skills among students of the College of Education at the University of Jordan were calculated according to the variables of gender and years of study, as shown in Table (5).

Table (5) Arithmetic means and standard deviations of the responses of the study members at the level of scientific thinking skills among the students of the College of Education at the University of Jordan according to the study variables

variable	Levels		Defining the problem	Making hypotheses	Hypothesis validity testing	Interpretation	generalization	Total scale
Gender	males N=109	Arithmetic mean	3.07	2.26	2.26	2.24	2.03	11.85
		Standard deviation	1.39	1.35	1.14	1.20	1.20	3.38
	females N=260	Arithmetic mean	3.06	2.33	2.60	2.32	2.32	12.63
		Standard deviation	1.40	1.34	1.29	1.32	1.34	3.70
	Total N=369	Arithmetic mean	3.06	2.31	2.50	2.30	2.23	12.40
		Standard deviation	1.40	1.34	1.25	1.29	1.30	3.62
Years of study	First N=28	Arithmetic mean	3.04	2.61	2.18	2.14	2.43	12.39
		Standard deviation	1.67	1.45	1.52	1.27	1.48	4.82
	Second N=94	Arithmetic mean	2.89	2.24	2.61	2.32	2.18	12.24
		Standard deviation	1.36	1.37	1.31	1.41	1.26	3.44
	Third N=159	Arithmetic mean	3.04	2.30	2.44	2.33	2.33	12.43
		Standard deviation	1.36	1.28	1.21	1.27	1.29	3.52
	Fourth N=88	Arithmetic mean	3.28	2.32	2.58	2.26	2.06	12.50
		Standard deviation	1.41	1.39	1.17	1.20	1.32	3.61
	Total N=369	Arithmetic mean	3.06	2.31	2.50	2.30	2.23	12.40
		Standard deviation	1.40	1.34	1.25	1.29	1.30	3.62

Table (5) shows that there are apparent differences between the average responses of the study members at the level of scientific thinking skills among students of the College of Education at the University of Jordan, according to the variables of gender and years of study. To indicate the significance of the statistical differences between the arithmetic means, a two-way multivariate analysis of variance test (2-Way MANOVA) was used. Table (6) shows this.

Table (6) Results of the two-way multivariate analysis of variance (2 Way MANOVA) for the responses of the study members at the level of scientific thinking skills among the students of the College of Education at the University of Jordan according to the study variables

Source of variance	skills	Total squares	Freedom degrees	Square mean	F value	Significance level
Gender	Defining the	.719	1	.719	.398	.528

Source of variance	skills	Total squares	Freedom degrees	Square mean	F value	Significance level
Hotelling's = 0.026 Sig0.096 =	problem					
	Making hypothesis	8.266	1	8.266	5.326	.022*
	Hypothesis validity testing	.373	1	.373	.224	.637
	interpretation	6.803	1	6.803	4.035	.045*
	generalization	45.938	1	45.938	3.506	.062
	Total scale	7.084	3	2.361	1.210	.306
Year of study Wilks' Lambda =0.965 Sig0.597 =	Defining the problem	3.166	3	1.055	.584	.626
	Making hypothesis	4.501	3	1.500	.967	.409
	Hypothesis validity testing	.839	3	.280	.168	.918
	interpretation	5.732	3	1.911	1.133	.336
	generalization	3.294	3	1.098	.084	.969
	Total scale	.719	1	.719	.398	.528
Error	Defining the problem	710.463	364	1.952		
	Making hypothesis	657.530	364	1.806		
	Hypothesis validity testing	564.903	364	1.552		
	interpretation	607.463	364	1.669		
	generalization	613.690	364	1.686		
	Total scale	4769.169	364	13.102		
Total	Defining the problem	717.566	368			
	Making hypothesis	661.160	368			
	Hypothesis validity testing	578.244	368			
	interpretation	608.802	368			
	generalization	625.957	368			
	Total scale	4818.439	368			

*Significant at (α=0.05).

It is evident from Table (6) that:

There are no statistically significant differences at the level (α = 0.05) between individuals' responses to each of the skills (defining the problem, testing the validity of the hypothesis, generalization) due to the difference in the gender variable, as the statistical values (f) on the skills were (0.398) (0.224) (3.506) and at the significance level (0.528) (0.637) (0.062), respectively. All of these values are not statistically significant at (α = 0.05). The table also shows that there are statistically significant differences between individuals' estimates of each of the skills (hypothesis development, interpretation) due to the difference in gender. The statistical value (f) on the skill of making hypotheses reached (5.326) and the level of significance (0.022), while the statistical value (f) on the skill of interpretation reached (4.035) and the level of significance (0.045). These values are considered statistically significant at (α = 0.05). And the differences on the skill of hypothesis-making and the skill of interpretation were in favor of females with a higher mean than males. The table also shows that there are no statistically significant differences at the level

of significance (α = 0.05) between the average estimates of individuals on the total score of the scale due to the difference in gender. In this context, the statistical value of the (f) test on the scale as a whole was (1,210) at the significance level (0.306). This value is not statistically significant at the significance level (α = 0.05).

There are no statistically significant differences at the level (α = 0.05) between individuals' responses to each of the skills (defining the problem, setting hypotheses, testing the validity of the hypothesis, interpretation, and generalization) due to the different years of study. The statistical values of (f) on skills were (0.584), (0.967) (0.168) (1.133) (0.084) and (0.626) (0.409) (0.918) (0.336) (0.969), respectively. All of these values are not statistically significant at (α = 0.05). The table also shows that there are no statistically significant differences at the level of significance (α = 0.05) between the average estimates of individuals on the total score of the scale due to the different years of study. The statistical value of the (f) test on the scale as a whole was (0.398) with a significance level (0.528). This value is not statistically significant at the significance level (α = 0.05). The researchers attribute this result to the social and educational environment in which the students live, in addition to the same conditions and suffering resulting from the spread of the Corona virus.

This made it difficult for students to analyze the problem and develop solutions and alternatives to deal with distance education, in addition to the nature of distance education, which did not give students the opportunity to discuss, dialogue and ask questions other than face-to-face learning. The students' fear of the effects of the pandemic, both in terms of health, psychological and educational, had a major role in exhausting students' thinking with scientific thinking skills and reaching positive results about the nature of their distance studies. The results of the current study agree with (Miqdadi, 2020) about the absence of differences in the estimations of the sample members according to the gender variable, as well as with (Al-Muzaini and Al-Muhamadi, 2019), which indicated that there are no differences in students' attitudes towards using the e-learning system in education according to their gender.

The results of this study differ with Al-Juhani (2021), which indicated that there are statistically significant differences due to the effect of gender in both self-learning and distance learning in favor of females. The results also indicated that there is a positive relationship between self-learning and distance learning in light of the Corona pandemic. In this context, the results of this study agreed with (Cicha, Rizun, Rutecka & Strzelecki, 2021), which indicated that there are factors that affect students' feelings and can persuade them to learn at a distance, and they are represented in the feeling of pleasure in this type of education and a sense of self-efficacy that the university students enjoy.

Conclusion and Recommendations:

Based on the importance of the topic studied, which is distance education, this study comes to reveal the impact of distance learning on scientific thinking skills among students of the University of Jordan during the spread of the Corona virus. It was noted that there is a lack of studies examining the variables of the current study. Thus, there is a need to conduct studies that address the variables of the current study. This study was limited to a sample of students from the College of Education at the University of Jordan, and the descriptive analytical method was used for its suitability to the nature of this study.

After conducting the necessary statistical analyses, the results of the study showed that the level of scientific thinking skills among the students of the University of Jordan during the spread of the Corona virus was low, because the skills of defining the problem, testing the validity of the hypothesis, developing hypotheses, interpretation, and generalization all recorded a low level among the students of the University of Jordan. The results showed that there were no apparent differences between the average responses of the study members at the level of scientific thinking skills among the students of the College of Education at the University of Jordan, according to the variables of gender and years of study.

The study recommended conducting training courses on scientific thinking skills during distance learning for students, developing curricula specialized in scientific thinking skills as a prerequisite in the first year of university studies, and building an educational mechanism that takes into account all regions of the Kingdom in case of future crises.

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