

Undergraduate students' perceptions of the use of simulation software through online learning in colleges of engineering during the covid-19 pandemic: A case study at al-Balqa applied university, Jordan

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ABSTRACT

Students at Al-Balqa' Applied University, Jordan, are being interviewed about their experiences with online simulation software during the Covid-19 pandemic. In this study, a descriptive method was employed. 667 undergraduate students were asked to fill out a 25-item questionnaire. During the Covid-19 epidemic, undergraduate students showed a modest level of proficiency in using simulation software via online instruction, according to the study's findings. Al-Balqa' Applied University undergraduate students' perspectives vary according to gender (in favor of females) and discipline, according to the findings (in favor of the Electrical engineering discipline.). Academic evaluation, on the other hand, does not show any statistically significant differences amongst pupils. As a result, there appears to be no statistically significant difference in academic evaluation across pupils (GPA). It's important to do more research like this one on simulation software implementation in higher education institutions, according to this study.

Keywords: Simulation software; Online learning; Engineering Colleges; Covid-19 Pandemic

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1. Introduction

Today, the world lives in an era of scientific and technological advances and scientific openness that has overcome obstacle and challenge and improved communication between individuals and people regardless of distance and the phenomenon of globalization that has shifted attention to the global community along with continuous and rapid change in the way we live. The impact of the scientific and technological revolution has been felt in all aspects of life. Education is one such important aspect. This is evident in curricula, teaching methods, and evaluation strategies. A good example of this is the concept of teaching evolving into what is known as interactive teaching, which depends on interactive computer programs [1].

Simulation software, according to [2] served as a complement to traditional teaching methods in the classroom. Furthermore, [3] emphasized that new technologies and software have allowed simulation to become an advanced tool that reflects real situations very precisely. We all know that the unexpected advent of the Covid 19 has had major impacts on all countries in all aspects, and it is undeniable that the education sector is one of the most affected sectors from this pandemic. Nonetheless, in the wake of the severity of the pandemic, the educational system in most countries has been moved to create and implement modern learning strategies to ensure the continuity of education and training in order to support the learnability to adapt to the

new environment of this Pandemic [4]. Universities, colleges, and schools have made the decision to shift their teaching and learning processes from face-to-face to online learning and use alternative teaching methods [5].

The term online learning refers as is a form of distance education in which technology mediates the learning process, teaching is provided entirely via the internet, and learners and teachers are not required to be present at the same time and location [6]. Online education has grown in popularity, and as a result, governments around the world have begun to sponsor initiatives to raise the standard of online education [7]. [8, 9] contrast this by stating that online learning is a direct outgrowth of the constructivist theory of learning, which switched the focus from teacher-centered instruction to learner-centered instruction, giving students a greater sense of agency and ownership over their education.

The study in [10] defines the outputs of technical-laboratory domains as those that emphasize the necessity of combining theoretical information with practical abilities in a way that is relevant to the discipline. For practical skills, emphasis is placed on activities that allow students to explore experimental methodologies, synthesize observations, and an array of communication skills, as well as proper equipment and laboratory practices [11]. Because of the rapid development of digital technology throughout the first decade of the twenty-first century, online learning has become increasingly popular in a variety of educational contexts [12]. Web-based activities are used heavily in distance education courses, whereas blended instructional approaches are used as support for teaching and learning in campus-based courses.

Using web-based e-learning tools to do hypothesis testing and predictions prior to the practical class, evaluate the results, and then review the submitted predictions after the class is described as a blended learning technique by [13]. Thus, students are deprived of hands-on experience and the ability to fully comprehend how it feels to be immersed in such an environment by functioning in a distance learning mode [14]. Therefore, it is imperative that educational institutions carry out an in-depth review of how they are currently facilitating lab-based practical experiments and technical training courses for their students, as well as how they will be implemented in the post-COVID-19 period, especially in order to achieve learning outcomes, especially in light of COVID-19. So as the curricula moves online during these challenging times the world is going through Covid-19 a pandemic, teaching laboratory and technical subjects becomes a challenge on the part of both students and educators. So, Programmers and engineers have therefore created a large number of simulation applications that can be used to support how instructors are presenting the concepts of technical courses to their students.

According to [16] there are plenty of software simulation programs available in the engineering academia, but only few of them proved to be up to the educational standards and requirements. Al- Balqa' Applied University (BAU) as one of the famous higher educational institutions in Jordan is not exempted from this significant adjustment. Its Colleges of Engineering have found it a struggling process on how to deliver hands-on, technical subjects and electronic laboratories like Circuits courses with maintaining a high-quality educational experience. Hence, the Engineering colleges had found an idea in teaching students practical Engineering courses through online learning like practical Circuits courses by using simulation software during the Covid-19 spread, like how to connect electric circuits the right way, how to determine if connected circuits function correctly, how to visualize the movement of electricity, and how to put into practice the theories presented. The current study aims to explore the perspective of engineering students at Al Balqa Applied University on the effectiveness of the Multisim software they used During their study of engineering courses during the spread of Covid-19 pandemic.

Multisim is without a doubt one of the leading programs in the engineering academic field, for its ability to accurately simulate components behavior and build complex circuit schematics . To accurately predict the functionality of electronic circuits, Multisim uses SPICE which is a modeling program developed by University of California at Berkeley [17]. Alongside the usual simulation schemes, the educational version of Multisim added the breadboard view feature that allows students to experience real-life connection scenarios and learn from common mistakes that may not be very clear using the regular simulation schemes . Figure 1 (a) shows an example of circuit simulation of a basic clipper circuit for Electronic Devices and Circuits 1 course, the software allows the students to connect the circuit and view the expected output using measurement tools such as Oscilloscope as seen in Figure 1 (b).

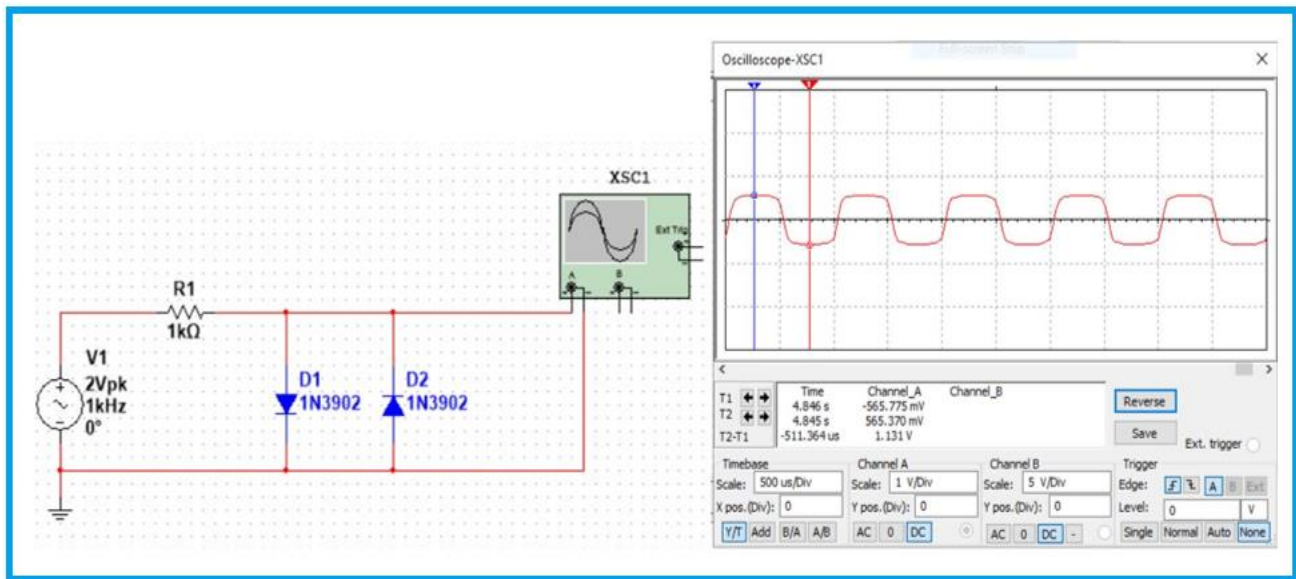


Figure 1. (a) Simulation of clippers circuit using Multisim. ;(b) Measuring the output of the circuit using an oscilloscope

Additionally, the breadboard view option allows the student to visualize practical connection of the same circuit that was simulated. Figure 2 shows how the breadboard layout mimics actual connections accurately.

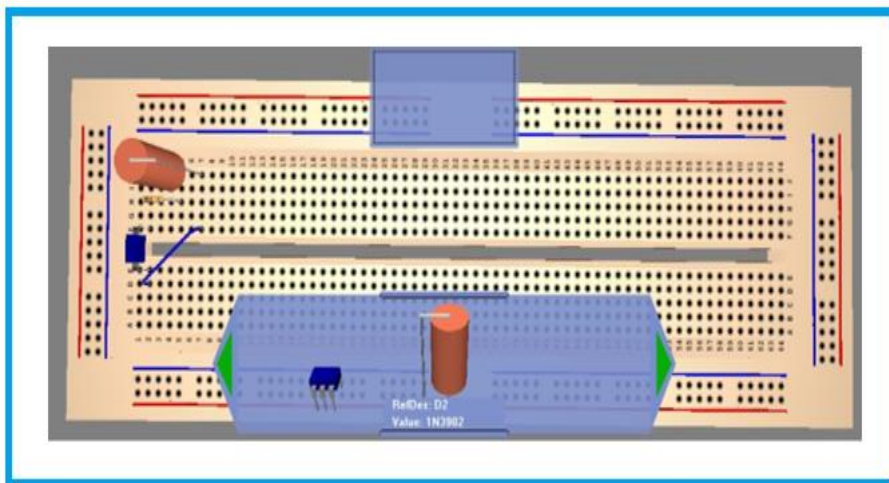


Figure 2. Breadboard Layout of Clipper circuit

Numerous studies have discussed the use of Multisim as a simulation tool in education, such as the use in teaching engineering courses [18, 19] [20] [21]. This includes Guo-hong, Shui ying and Jing jing's work ([22] Guo-hong, Shui-ying and Jing-jing, 2011) which aims to investigate and test diverse schematic difficulties for electrical engineering students at different academic levels. Students' performance was evaluated using numerous modules for different groups, and the results were compared in a study [23] targeted at studying the simulation laboratory platform utilizing Multisim. Using the Multisim program has yielded outstanding educational outcomes. Furthermore, the results show that students may learn by experimenting with development platforms such as Multisim, which provides them with the creative tools to translate the theoretical knowledge they learned in the classroom. This course is an excellent introduction to working with electrical and electronic systems in real-world settings. Students can take this platform home with them and use it for homework assignments in electrical circuits, dynamics of systems, and control classes because it is straightforward to construct and interface with any computer. This opens up new opportunities for practical tasks in these courses. Furthermore, a study by [25] shows that utilizing Multisim as a teaching tool can help students learn electrical circuits, including series-parallel circuit analysis, superposition theory, Thevenin theory, and Norton theory. By using the Technique and Multisim software, students may verify that their

calculations are accurate at every step in the process, allowing them to identify and correct their own mistakes and enhance their comprehension.

1.1. Study problem

COVID 19 has had a great impact on many aspects of daily life today because of the pandemic that is occurring. In response to the sudden and rapid change of the educational system from a traditional learning environment to an online learning environment during this Pandemic, students' attitude towards learning has been greatly impacted in a significant way. Thus, the purpose of the current study is to investigate the application of simulation software through online learning at the engineering colleges during the Covid-19 agenda in one of Jordan's higher education institutions in the academic year 2019/2020 via exploring undergraduate students' perceptions of using simulation software through online learning at the engineering colleges in the Al- Balqa' Applied University.

1.2. Study questions

The current study seeks to answer the following questions:

RQ1: How effective are simulation software through online learning during Covid-19 pandemic in the Colleges of Engineering of Al- Balqa' Applied University in Jordan from Undergraduate students' perspective.

RQ2: Does the effectiveness of Simulation Software through online learning in the colleges of engineering during the Spread of the Covid-19 Pandemic vary, from the undergraduate students' perspective, according to gender, disciplines and students' GPA.

1.3. Significance of the study

The significance of the study is demonstrated as follows:

- In this investigation, it will explore undergraduate students' perceptions regarding the implementation of Multisim simulation software through the students' online learning program during the spread of the Covid-19 pandemic.
- This investigation may contribute to providing a clear picture of the difficulties and challenges faced by students while implementing Multisim simulations as software programs used during the Covid-19 pandemic.
- Teachers will also gain from the benefits of this study, when teachers are properly guided, they can also create their own meaningful problems to deal with electric circuit applications by using simulation applications, it is also possible to obtain real-time feedback on their work.

2. Methodology

2.1 Approach of the study

The current analysis was carried using a descriptive method approach, which is a type of research that describes the population, condition, or phenomena under-examined through gathering quantifiable data that can be used for statistical analysis [13]. Thus, a questionnaire instrument will be used to gather data from a sample of the population represented to the participants.

2.2 Population of study

The study population consisted of all undergraduate students on the campus of Al-Balqa Applied University in Jordan who enrolled in the second semester of the academic year 2019/2020 and used the Multisim software during the spread of the COVID-19 pandemic. As the total number of undergraduate students was 3,335, as shown in Table 1.

Table 1. Study population

#	Disciplines	f	(%)
1	Electrical engineering	460	13.79%
2	Civil Engineering	549	16.46%
3	Mechanical Engineering	697	20.90%

#	Disciplines	f	(%)
4	Computer and network systems engineering	229	6.87%
5	Computer Engineering	328	9.84%
6	Communication technology engineering	225	6.75%
7	Mechatronics engineering	347	10.40%
8	Thermal and hydraulic machines engineering	159	4.77%
9	Chemical Engineering	341	10.22%
Total		3335	100.00%

2.3. Sample of study

- A sample of 20 % of the population of each Discipline was taken by the investigators, where they used the random sampling method through a stratified sample technique to determine the sample for this study, which totalled 667 ($3335 * 20/100 = 667$) students, for example students of the Discipline of Electrical engineering, $460 * 20/100 = 92$ students and as a percentage of the total sample of Discipline of Electrical engineering will $92 / 667 * 100 = 13.79\%$. The same thing is being done for the other colleges. A total of 667 questionnaires were distributed to undergraduate students in order to collect the necessary data to achieve the objectives of this study. In total, 603 questionnaires were returned with the correct response and in full. A number of undergraduate students ($n=64$) across all of the select disciplines did not correctly respond to the questionnaire. As a result, the sample size was reduced to 603 students. As shown in Table 2, the demographic data for the selected sample of students who answered the questionnaire correctly were shown.

Table 2. The demographic information of the study sample

Study variables	Variables levels	Frequency (f)	Percentage (%)
Gender	Female	292	48.4%
	Male	311	51.6%
	Total	603	100.00%
Disciplines	Electrical engineering	92	13.79%
	Civil Engineering	110	16.49%
	Mechanical Engineering	139	20.84%
	Computer and network systems engineering	46	6.90%
	Computer Engineering	66	9.90%
	Communication technology engineering	45	6.75%
	Mechatronics engineering	69	10.34%
	Thermal and hydraulic machines engineering	32	4.80%
	Chemical Engineering	68	10.19%
Total	1742	100.00%	
Students' GPA	2- less than 2.5	193	32.01%
	2.5 - less than 3	251	41.63%
	3 - less than 3.5	96	15.92%
	3.5 -4	63	10.45%
	Total	603	100.00%

2.4. Study tools

The survey was used to collect data from the sample of undergraduate students of Al- Balqa' Applied University in Jordan and was distributed to them during the second semester of the 2019/2020 academic year, throughout the spread of the COVID-19 pandemic. During the questionnaire development process, the literature and related studies in this field, such as studies conducted by [26, 27]. The questionnaire was divided into two parts: the 1st contained basic information about the students, and the 2nd contained questionnaire items (n=25) premised and concentrated on the aims of the study.

- **The validity and reliability of the instrument**

A group of adjudicators (5 academic staff from Jordan universities and 5 UAE Universities) with extensive experience in the area of learning have been asked to voice their attitudes on the items of the questionnaire in relation to the study for accomplishing study aims and the number completeness of the questionnaire items. The academic experts' modifications and recommended improvements have been taken from the removal, revision, and addition, and as a consequence, the questionnaire after reform composed of (25) Items, in order to accomplish the study objectives. Similarly, the reliability of internal consistency was calculated using Cronbach's Alpha. Table 3 displays values of Cronbach's Alpha reliability factors. Additionally, the overall alpha reliability coefficient of Cronbach (0.873), this implies a reasonable degree of usage.

Table 3. Cronbach's Alpha reliability coefficients

No.	Item (I)	Cronbach's Alpha	No.	Item	Cronbach's Alpha
1	It.1	0.867	14	It.14	0.863
2	It.2	0.862	15	It.15	0.869
3	It.3	0.865	16	It.16	0.869
4	It.4	0.873	17	It.17	0.865
5	It.5	0.866	18	It.18	0.864
6	It.6	0.866	19	It.19	0.868
7	It.7	0.865	20	It.20	0.872
8	It.8	0.885	21	It.21	0.863
9	It.9	0.877	22	It.22	0.867
10	It.10	0.872	23	It.23	0.862
11	It.11	0.867	24	It.24	0.870
12	It.12	0.864	25	It. 25	0.869
13	It.13	0.881			
Total				0.873	

3. Data analysis measures

In this analysis, a five-dimensional Likert scale is implemented as follows seen in (Table 4.)

Table 4. The evaluation of scale data based on the options of scale and score intervals

Description	Scores	Intervals
Very high	5	4.21–5.00
High	4	3.41–4.20
Moderate	3	2.61–3.40
Low	2	1.81–2.60
Very low	1	1.00–1.80

3.1. Statistical analysis of the data

Statistical Package for Social Sciences (SPSS) was used to perform percentage, mean, SD, t-test, one-way ANOVA, and Scheffe test computations on the data collected by the researchers.

4. Findings

4.1. Findings of the study relative to RQ 1

RQ1: How effective are simulation software through online learning during Covid-19 pandemic in the Colleges of Engineering of Al- Balqa' Applied University in Jordan from Undergraduate students' perspective.

Researchers assessed the mean and standard deviation of the responses of the study sample for students on each item (1-25) of the instrument and organized them in descending order according to their means in Table 5.

Table 5. Means and standard deviation arranged in descending order for the responses of the students' regarding to degree of effective of simulation software through online learning during Covid-19 pandemic

No.	Paragraphs	Mean	SD	Description
Q1	I feel that simulation software helps to improve my skills during studying engineering topics. (3)	3.49	0.99	High
Q2	Simulation software helps Engineering students to solve and manage complex engineering topics.	3.43	1.02	High
Q3	Simulation software motivates me to participate actively in the learning process.	3.45	1.06	High
Q4	Simulation software has helped me better understand the content of the engineering topics lectures.	3.20	1.13	Moderate
Q5	Simulation software has helped me in self-development to understand and interpret engineering experiments.	3.21	1.08	Moderate
Q6	The Simulation software increase and enhancement of my self-confidence.	3.27	1.05	Moderate
Q7	Simulation software helps me to gain a deeper understanding of practical engineering courses.	3.29	1.05	Moderate
Q8	I feel that simulation software considers the safety of students from risky engineering experiments	3.45	1.12	High
Q9	The Simulation software leads to an increase in communication between students - students and students with the instructor.	3.18	1.17	Moderate
Q10	I feel that repeated practice of the procedure in Simulation software will improve my understanding and academic performance	3.34	1.05	Moderate
Q11	I believe that the feedback provided by simulation software at the end is better than that of the traditional method.	3.13	1.08	Moderate
Q12	I believe that simulation tools should be integrated into the curriculum in engineering and the content of the course.	3.40	1.04	Moderate
Q13	I feel that simulation software helps engineering students' to improve trust when dealing with real practical experiments.	3.32	1.12	Moderate
Q14	I believe that simulation software should be used as an assistant to actual engineering experiments and not as a substitute for it. (2)	3.52	1.08	High
Q15	I think that simulation software makes learning practical engineering courses topics easier.	3.35	1.07	Moderate

No.	Paragraphs	Mean	SD	Description
Q16	I think that simulation software creates a highly realistic, safe, and reproducible learning environment. (4)	3.47	1.09	High
Q17	I think that simulation software minimized the role of the instructor during the learning process.	3.27	1.06	Moderate
Q18	I think that simulation software maximized the role of the student during the learning process. (5)	3.46	1.01	High
Q19	I feel that the instructor will minimize his efforts if simulation software becomes a part of the engineering curriculum.	3.44	1.07	High
Q20	I feel that simulation software has helped students understand the engineering concepts better.	3.21	1.08	Moderate
Q21	I think that simulation software has helped engineering students to improve their critical thinking.	3.43	1.03	High
Q22	I feel that simulation software makes me nervous during learning engineering topics.	3.11	1.11	Moderate
Q23	I feel that simulation software makes me less nervous and more positive, interested, and more dedicated to learning.	3.31	1.06	Moderate
Q24	I feel that simulation software can be a partial substitute for actual practical engineering experiments.	3.19	1.10	Moderate
Q25	I found the simulation software flexible to use in relation to time and place. (1)	3.55	1.05	High
Total		3.34	1.07	Moderate

According to Table 5, the mean for all items (1-25) was 3.34 (SD 1.07), indicating that students at Al-Balqa Applied University perspective the effectiveness of simulation software through online learning came in Moderate degree. It is also evident from Table 5 that the students' answers to Q-25 ('I found the simulation software flexible to use in relation to time and place.') was given the highest mean value (3.55) at a high degree, and Q-14 ('I believe that simulation software should be used as an assistant to actual engineering experiments and not as a substitute for it') came in second, also at a high level with a mean value of (3.52). Q-1 ('I feel that simulation software helps to improve my skills during studying engineering topics.') came in third, at a high level with a mean value of 3.49. Moreover, Q-16 ('I think that simulation software creates a highly realistic, safe, and reproducible learning environment.') came in fourth, also at a high degree about the effectiveness of simulation software with a mean value of 3.68. In the same way, a high degree also obtained for Qs 18, 3, 8, 20, 2 and 21 with the respective mean values of 3.46, 3.45, 3.45, 3.44, 3.43 and 3.43. The lowest mean (3.11) was acquired for Q-22 ('I feel that simulation software makes me nervous during learning engineering topics.'), came at a moderate degree. In the same way, a moderate degree also obtained for Qs 12, 15, 10, 13, 23, 7, 6, 17, 5, 20, 4, 24, 9, and 11, with the respective mean values of 3.4, 3.35, 3.34, 3.32, 3.31, 3.29, 3.27, 3.27, 3.21, 3.21, 3.20, 3.19, 3.18, and 3.13.

3.2. Findings of the study attributed to Question 2

RQ2: Does the effectiveness of simulation software through online learning in the colleges of engineering during the spread of the covid-19 pandemic vary, from the undergraduate students' perspective, according to gender, disciplines and students' GPA. T-test, one-way ANOVA, and Scheffe's post-hoc comparison tests were used to examine the statistical significance of the differences in averages between the questions. Following is a breakdown of the results based on the various study variables.

First: Gender variations among students

T-tests were employed to examine the significance of the differences in averages between the genders of the undergraduate students when it came to the usefulness of simulation software through online learning during the Covid-19 epidemic. Table 6 shows the averages of the student responses.

Table 6. Means and SD of the Students' Answers Based on Gender

Gender	N	Mean	SD	Mean Difference	T. Value	df	Sig.
Female	299	3.36	0.668	0.18782	3.432	601	0.001*
Male	304	3.18	0.675				

* Statistically significant at (p<0.05)

At a significance level of 0.001, the results showed that the computed t value of 3.432 was more than the (t) table, suggesting that male and female mean values differed significantly (in favor of females) at the statistical significance level of 0.001. (0.05). Al-Balqa Applied University's female undergraduate students believe online simulation software is more effective than that of male students.

Second: Disciplines variations among students

Students at Al- Balqa' Applied University utilized a one-way ANOVA test to compare the efficiency of simulation software through online learning during the Covid-19 pandemic, with the degree of effectiveness varying by discipline among students. Table 7 displays the results of a one-way ANOVA on this particular variable.

Table 7 clearly shows that students' viewpoints differ according to the variable of disciplines, as the p-value is 0.000, which is less than the required statistical significance threshold (0.05).

Table 7. One-way ANOVA test for disciplines Variable Among Students

		Sum of squares	df	Mean square	F	Sig. (tailed)
College variable	Between Groups	23.295	8	2.912	6.825	0.000
	Within Groups	253.413	594	0.427		
	Total	276.708	602			

* Statistically significant at (p<0.05)

Therefore, the Scheffe test was employed to compare the following comparisons, and the results are displayed in Table 8 below. According to Table 8, it is clear that students in the Electrical engineering discipline have a more positive outlook on their future careers than their peers.

Table 8. Scheffe test results according to disciplines variable

(I) Disciplines	(J) Disciplines	Mean Difference (I-J)	Sig.
Electrical engineering	Civil Engineering	0.27234	0.873
	Mechanical Engineering	.56818*	0.033
	Computer and network systems engineering	.56968*	0.031
	Computer Engineering	0.04301	1.000
	Communication technology engineering	0.08047	1.000
	Mechatronics engineering	0.19158	0.987
	Thermal and hydraulic machines engineering	0.33396	0.656
	Chemical Engineering	0.45400	0.231
Civil Engineering	Electrical engineering	-0.27234	0.873
	Mechanical Engineering	0.29583	0.441
	Computer and network systems engineering	0.29733	0.423

(I) Disciplines	(J) Disciplines	Mean Difference (I-J)	Sig.
	Computer Engineering	-0.22933	0.879
	Communication technology engineering	-0.19187	0.937
	Mechatronics engineering	-0.08076	1.000
	Thermal and hydraulic machines engineering	0.06162	1.000
	Chemical Engineering	0.18166	0.941
Mechanical Engineering	Electrical engineering	-.56818*	0.033
	Civil Engineering	-0.29583	0.441
	Computer and network systems engineering	0.00150	1.000
	Computer Engineering	-.52517*	0.011
	Communication technology engineering	-.48771*	0.013
	Mechatronics engineering	-0.37660	0.167
	Thermal and hydraulic machines engineering	-0.23421	0.728
	Chemical Engineering	-0.11418	0.997
Computer and network systems engineering	Electrical engineering	-.56968*	0.031
	Civil Engineering	-0.29733	0.423
	Mechanical Engineering	-0.00150	1.000
	Computer Engineering	-.52667*	0.010
	Communication technology engineering	-.48921*	0.011
	Mechatronics engineering	-0.37810	0.157
	Thermal and hydraulic machines engineering	-0.23571	0.713
	Chemical Engineering	-0.11568	0.996
Computer Engineering	Electrical engineering	-0.04301	1.000
	Civil Engineering	0.22933	0.879
	Mechanical Engineering	.52517*	0.011
	Computer and network systems engineering	.52667*	0.010
	Communication technology engineering	0.03746	1.000
	Mechatronics engineering	0.14857	0.993
	Thermal and hydraulic machines engineering	0.29095	0.614
	Chemical Engineering	0.41099	0.156
Communication technology engineering	Electrical engineering	-0.08047	1.000
	Civil Engineering	0.19187	0.937
	Mechanical Engineering	.48771*	0.013
	Computer and network systems engineering	.48921*	0.011
	Computer Engineering	-0.03746	1.000
	Mechatronics engineering	0.11111	0.999
	Thermal and hydraulic machines engineering	0.25349	0.711
	Chemical Engineering	0.37353	0.197
Mechatronics engineering	Electrical engineering	-0.19158	0.987
	Civil Engineering	0.08076	1.000
	Mechanical Engineering	0.37660	0.167
	Computer and network systems engineering	0.37810	0.157
	Computer Engineering	-0.14857	0.993
	Communication technology engineering	-0.11111	0.999
	Thermal and hydraulic machines engineering	0.14238	0.988
	Chemical Engineering	0.26242	0.704

(I) Disciplines	(J) Disciplines	Mean Difference (I-J)	Sig.
Thermal and hydraulic machines engineering	Electrical engineering	-0.33396	0.656
	Civil Engineering	-0.06162	1.000
	Mechanical Engineering	0.23421	0.728
	Computer and network systems engineering	0.23571	0.713
	Computer Engineering	-0.29095	0.614
	Communication technology engineering	-0.25349	0.711
	Mechatronics engineering	-0.14238	0.988
	Chemical Engineering	0.12004	0.995
Chemical Engineering	Electrical engineering	-0.45400	0.231
	Civil Engineering	-0.18166	0.941
	Mechanical Engineering	0.11418	0.997
	Computer and network systems engineering	0.11568	0.996
	Computer Engineering	-0.41099	0.156
	Communication technology engineering	-0.37353	0.197
	Mechatronics engineering	-0.26242	0.704
	Thermal and hydraulic machines engineering	-0.12004	0.995

* Statistically significant at (p<0.05)

- **Second: Students' GPA variations among students**

For the purpose of assessing the significance of the variations in averages of Al-Balqa' Applied University undergraduate students' reporting the efficacy of simulation software through online learning during Covid-19, a one-way ANOVA test was utilized. To examine this variable in further depth, we used a one-way ANOVA test (see Table 9).

Table 9. One-way ANOVA test for students' GPA Variable Among Students

		Sum of squares	df	Mean square	F	Sig. (tailed)
College variable	Between Groups	2.591	3	0.864	1.887	0.131
	Within Groups	274.117	599	0.458		
	Total	276.708	602			

* Statistically significant at (p<0.05)

The above table shows that the value of P is equal to 0.131 which is bigger than the value of 0.05 and indicates that the value is does not have bigger value (0.05) in which means there is no statistically significant differences in students' viewpoints based on the variable of students' GPA.

4. Discussion

The findings achieved relating the RQ1, regarding the effective of simulation software through online learning during Covid-19 pandemic in the Colleges of Engineering of Al- Balqa' Applied University in Jordan from Undergraduate students' own perspective, according to Table 5, the results referred that the mean for all items (1-25) was 3.34 (SD 1.07), indicating that the perspective of students of Al-Balqa Applied University about the effective of simulation software through online learning came in Moderate degree. The moderate result might mean that some of the undergraduate students at Al-Balqa Applied University accepted the implementation of simulation software during the COVID-19 pandemic, while others did not, preferring it. Based on the results in Table 5, related to the students' responses to the questionnaire items, it was noted that

some of their responses indicated positive attitudes towards the implementation of electronic exams at Al-Balqa' Applied University during the Covid-19 pandemic. Table 5 presents the results of the students' responses to the questionnaire items. It is evident from the results that some of the students' responses were convincing and welcomed and that their attitudes towards the implementation of simulation software at Al-Balqa' Applied University during the Covid-19 pandemic were positive. Specifically, the items Qs 25, 14, 1,16,18, 3, 8, 20, 2 and 21 all indicated high degrees of acceptance from the respondents. Possibly, this is due to the fact that simulation software offers a way for students to be able to visualize engineering fundamental concepts better. Additionally, it is widely believed that undergraduate students gain a greater understanding of the course material by using simulation software, but more work needs to be done to assess the influence simulation software has on students' performance in the course and on their recall of the concepts in later courses. Moreover, this indicates that undergraduate students might be pleased to accept the implementation of simulation software in their studying engineering courses during the Covid-19 pandemic spread, which may be due to reasons related to the features of a simulation software like: It helps the students to discover information in an interactive and dynamic way, may allow more modeling flexibility, saving time, lower cost, create an atmosphere of suspense and excitement with the educational situation, and It reduces the risk and therefore safer for students. These consequences are consistent with those of preceding studies [28] [18] [29] [20] [21]. The results of these studies indicated that students showed their acceptance of simulation software and believed that it positively affects their learning the engineering courses. Moreover, the results of these studies confirmed that simulation software help students to improve their critical thinking and learning and understanding of the content of the curriculum compared to traditional learning.

The second research question concentrated on determining whether the effectiveness of Simulation Software through Online Learning in the Colleges of Engineering during the Spread of the Covid-19 Pandemic vary, from the Undergraduate students' perspective, according to gender, disciplines, and students' GPA. Our findings (as seen in Tables 6, 7, 8, and 9,) showed that the effectiveness of Simulation Software through Online Learning from perspective of undergraduate students of Al- Balqa' Applied University varies according to gender in favor of females. This result means that female Al- Balqa' Applied University undergraduate students' acceptance the application of simulation software during the spread COVID-19 is greater than the acceptance of their male counterparts. Also, the results indicate that perspective of undergraduate students of Al- Balqa' Applied University differs based on disciplines (in favor of the Electrical engineering discipline.). However, there is no statistically significant difference among students according to the variable of academic evaluation. However, the variable of academic evaluation does not show any statistically significant differences across pupils (GPA). Research into the impact of simulation software on student accomplishment, motivation, and involvement is needed at higher education institutions to support the use of simulation software in learning processes.

5. Limitations of the study

Like any other analysis, this study has some limitations that should be acknowledged.

- First, this study was limited to students' responses, and the responses of undergraduate students in one university in Jordan as one of higher educational institutions.
- Second, Faculty members were not taken in this study.
- Third, the study was limited to a sample size of 667 students, representing 20% of the study population.

6. Conclusions and recommendations

Notwithstanding the aforementioned limitations, the following suggested educational implications and recommendations are provided for future research on the implementation of simulation software during and after the spread of the COVID-19 pandemic.

- Appropriate solutions need to be found to technical problems and detection for simulation software-specific errors
- It is necessary to provide technical support in addition to academic support on an ongoing basis while teaching engineering students via simulation software

- Similar studies should be performed on the implementation of simulation software in higher education institutions.

7. Delimitations of the study

- Location Limit: Al- Balqa' Applied University, Main campus, Amman, Jordan.
- Time Limit: Second semester of the academic year 2019/2020.
- Human Limit: Undergraduate students in engineering disciplines.

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