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Exploring the Entrepreneurial Knowledge, Skills, and Mindset of Jordanian University Engineering Graduates to Enhance Career Prospects

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Abstract: This study examined the entrepreneurial knowledge and skills of engineering graduates and the entrepreneurial mindset of engineers. It also examined how entrepreneurial knowledge and skills affect the mindset of the entrepreneurial engineer. The study population consists of twenty-five Jordanian public and private universities that offer engineering programs. Based on the results of an overview of the engineering study plans of these universities, four universities were selected (The University of Jordan, Princess Sumaya University for Technology, Al-Hussein Technical University, Al-Hussein Technical University, Al-Ahliyya Amman University). The total number of engineering graduates participating in this study and whose responses were valid for the analysis was 65 students who graduated between 2016 and 2022. The results of this study indicated that the average entrepreneurial knowledge and skills of engineering graduates ranged between average and good. The findings also indicated that there is a statistically significant positive correlation between the entrepreneurial knowledge and skills of engineering graduates and their entrepreneurial mindset. The study concluded that it is essential for undergraduate engineering students to acquire entrepreneurial knowledge and skills that support their engineering major, and lead them to think broadly about their future careers and opportunities. Thus, entrepreneurial knowledge and skills enhance their competitiveness in innovative and rapidly emerging engineering industries. The study recommended the inclusion of entrepreneurship knowledge and skills in all engineering curricula and courses in universities.

Keywords : Business Entrepreneurship; Engineering; Jordanian Universities.

1. Introduction

Entrepreneurship provides job opportunities through the creation, design and operation of new businesses, especially with the scarcity of vacancies in the public and private sectors and the high unemployment rates. Entrepreneurship and engineering share the same purpose of serving people and solving their problems (Huang-Saad et al., 2019). Several indicators show that there is a great need for engineers to acquire entrepreneurial knowledge and skills because today's business environment faces significant competitive challenges (Duval-Couetil et al., 2012) making entrepreneurship and innovation key success factors in engineering (Rodriguez et al., 2015).

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The process of adapting to the new reality requires a deep understanding of the need for change in the traditional education system. Universities around the world are increasingly realizing that they must graduate engineers who not only understand science and technology, but who are also able to identify gaps in the market, start their own business, conduct financial analysis, market new products, and manage various innovative engineering or non-engineering projects (Duval-Couetil et al., 2012). This process of adaptation has greatly increased the availability of entrepreneurship training for engineering students through multilevel courses that provide a deep understanding of innovation and entrepreneurial potential, as well as courses that provide theories on how to manage and bring innovative potential to the economy. Some universities around the world such as the Massachusetts Institute of Technology (MIT) and Stanford University are making these adjustments. Universities in different countries of the world must adapt and reshape the curricula of their engineering programs (Duval-Couetil et al., 2012).

Changes must be made to traditional education systems to advance the progress of modernization and renewal in countries (Dao, 2018). Universities need to adapt by adjusting traditional engineering curricula, as students' lack of entrepreneurship education leads to fewer engineers with valuable skills such as seeking opportunities, effective communication, negotiation and understanding business (Rodriguez et al., 2015). The valuable skills that lead to developing an entrepreneurial engineer mindset are not limited to one engineering track or discipline. Developing mindset will create better value wherever it is applied to engineering roles and tasks. The literature gap that this research seeks to address is the lack of research on the effectiveness of entrepreneurship courses offered by Jordanian universities in developing the entrepreneurial knowledge and skills of engineering graduates. Despite the increasing importance of entrepreneurship in the Jordanian economy, there is a lack of research on the impact of entrepreneurship courses on engineering graduates' entrepreneurial knowledge and skills. Additionally, there is a lack of research on the sources of entrepreneurial knowledge and skills among engineering graduates, as well as the relationship between entrepreneurial knowledge and skills, and the entrepreneurial engineer mindset. Furthermore, there is a lack of research on the impact of the entrepreneurial engineer mindset on job opportunities and prospects. Finally, there is a lack of research on the suggestions of engineering graduates on how to increase undergraduate students' entrepreneurial knowledge and skills. This research seeks to address these gaps in the literature.

This study examined the entrepreneurship courses offered by engineering students in their undergraduate curricula, in addition to examining the level of entrepreneurial knowledge and skills of engineering graduates, the level and extent of the entrepreneurial mindset of engineers. It also investigated the extent to which the entrepreneurial engineer mindset plays a role in expanding career opportunities and prospects.

Therefore, this study addressed the following questions:

1. What is the percentage of Jordanian universities that offer entrepreneurial courses for engineering students?

2. What is the level of entrepreneurial knowledge and skills of the selected Jordanian university's engineering graduates?

3. What are the key sources of entrepreneurial knowledge and skills of engineering graduates?

4. Are the entrepreneurship courses offered by universities effective in playing a significant role in building the graduates' entrepreneurial knowledge and skills?

5. Is there a relationship between the knowledge and skills of the engineer in the field of entrepreneurship and the mindset of the entrepreneurial engineer?

6. Does the entrepreneurial engineer mindset help expand job opportunities and prospects?

7. What do engineering graduates suggest as solutions to increase undergraduate students' entrepreneurial knowledge and skills?

2. Literature Review

Globalization and rapid technological changes have created significant challenges for the business sector. These critical changes require the need to create new paradigms to deal with the challenges. A solution that will play an important role in the economy, as an engine of innovation and job creation, is entrepreneurship education (Vodă and Florea, 2019).

It is now necessary to have creative minds who think with an entrepreneurial mindset that will help in creating new innovative entrepreneurial projects that contribute to promoting economic growth and creating new job opportunities (Vodă and Florea, 2019). This means that immersion in entrepreneurship education around the world is not only beneficial to developing economies but also helps students become more involved in pressing real-world problems, develop their critical thinking as well as expand their life skills. The first entrepreneurship course was introduced by Harvard Business School in the 1940s, after the end of World War II accompanied by major economic changes (Vesper and Gartner, 1997). Further progress appeared in the 1970s when other universities began to adapt and switch to the new educational system (Huang-Saad et al., 2019).

Today, top universities around the world are racing to offer their students the best entrepreneurship education systems, which include all the skills needed to help graduates launch their successful startups and think unconventionally before starting the business process. Courses can be categorized into basic business knowledge, entrepreneurship skills, business plan development and prototyping. These universities are known for their contribution to the startup scene. This encourages fresh undergraduate students to enroll in entrepreneurship universities when looking for knowledge and future growth opportunities.

Scientific research shows the importance and effectiveness of integrating university education with entrepreneurial skills, thus increasing the number of successful new venture capital. It is important to highlight the fact that university education should not be defined in the classroom only because the main goal is to develop an entrepreneurial mindset. Valuable educational content must be taught throughout the student's university life including workshops, labs, competitions, class projects, internships and practices. The main reason for all this is to maintain students' interest in entrepreneurship and to advance, develop and enhance their future career opportunities (Akpochafo and Alika, 2018).

Engineers tend to have logical, analytical, structured, and quantitative thinking that leads to problem-solving skills. If this is based on traditional engineering education, engineers may not be encouraged to explore innovative solutions. This highlights the gap in identifying customer expectations and needs (Karim, 2016). For engineering skills, technical design skills are essential for building aircraft, cars, energy systems, biotechnology and cities. However, engineers still need to work with people from other disciplines with diverse backgrounds and perspectives to carry out jobs. The engineer must adapt an effective communication strategy to be able to interact with professionals to implement a successful engineering innovation (Wood et al., 2004). This highlights the communication and strategic leadership skills gap for engineers to pioneer and lead future engineering innovations.

Recognition of the economic impact of innovation and entrepreneurship is constantly growing, and broad educational institutions in key areas such as science, technology, engineering, and mathematics (STEM) are increasingly influenced by entrepreneurship educational programs (Shekhar and Huang-Saad, 2021). STEM is now working to move entrepreneurship beyond the business school model as well as immerse themselves in entrepreneurship in their educational systems to create a more entrepreneurial mental strength technical force with advanced business, social and personal skills to contribute effectively to their organizational environment (Wood et al., 2004).

Engineering colleges have tried to apply innovation skills in engineering curricula (Duval-Couetil et al., 2012; Blake Hylton et al., 2020). Some universities such as Aalborg University in Denmark have adapted a blended learning experience of academic and technological knowledge of engineering, as well as various courses in project design and innovation.

The aspiration to professional freedom, to be a leader and a boss, and to become more respected is also always one of the influences that entrepreneurship courses give students. This drives students' energy towards a more diverse career path where they will be able to attract different innovative opportunities. This allows engineers to put all of their valuable skills and scientific and technological knowledge into practice.

Many authors have defined the entrepreneurial mindset. Entrepreneurial mindset is the inclination to discover, evaluate, and exploit opportunities. It is the habit of frequently using entrepreneurial thinking in your daily life, and constantly thinking about making a career out of starting businesses, both within

existing organizations and as independent ventures (McGrath and MacMillan, 2000). People who have been described as having an entrepreneurial mindset share a set of personal characteristics that can be developed over time, examples of these characteristics being a passion for looking for new opportunities, a discipline when pursuing opportunities and they are able to recognize and pursue the best opportunities with a strong focus on execution.

Analysis of the engineering and commercial industries indicates that there is a demand when it comes to engineers with an entrepreneurial mindset. The world of engineering is fast emerging and it is no longer adequate for engineering graduates to be only technically qualified. In today's world, when a new engineer is hired, a combination of skills (communication, interpersonal, problem solving) are essential, and these skills are usually associated with an entrepreneurial mindset.

As engineers are now expected to discover, evaluate, and exploit opportunities, they must learn how to work collaboratively with people with different experiences and backgrounds. Teamwork is essential to growing new innovative projects, and even if engineers are able to focus on product development and rely on other team members to work on turning the product into a viable business, they still need to understand the process and work together on a common goal by applying critical and creative thinking skills (Bosman and Fernhaber, 2018). This demand is not limited to the presence of entrepreneurial engineers in a particular engineering discipline or career path. Instead, developing an entrepreneurial engineer mindset will allow engineers to create better value and benefit from their expertise no matter where it is applied.

It is important to develop the engineers of the future and widening their career opportunities and prospects, as well as improve their abilities to become great leaders in their field.

Based on the literature review (e.g. Newport and Elms, 1997; Treanor, 2012; Rodrigues et al., 2012; Byers et al. 2013; KritiKoS, 2014; Barba-Sánchez and Atienza-Sahuquillo, 2018; Cheng et al., 2018; Holzmann et al., 2018; Saral and Alpkan, 2019; Roy et al., 2020; Baciu et al., 2020), there was a clear need for a study to investigate entrepreneurship education in Jordan. This study focused specifically on entrepreneurship education for undergraduate engineering students in Jordanian universities. Furthermore, it focused on how to develop entrepreneurial engineers and help them get more job opportunities.

3. Methodology

To study the impact of entrepreneurship education on engineering students in Jordanian universities, it is necessary to analyze what universities offer in their engineering curricula. Examining the available entrepreneurship and innovation courses leads to a better understanding of the student's participation in entrepreneurship during the undergraduate engineering journey. This allows an understanding of the evolution of the "entrepreneurial engineer mindset" of engineering graduates in Jordan.

The process of obtaining responses from study participants was divided into four steps as follows:

Step 1: Analyzing the curricula of engineering programs in all Jordanian universities.

Step 2: Identifying the universities into two groups; universities that offer entrepreneurship programs for engineering students (compulsory or elective courses), and universities that do not offer such courses for their students.

Step 3: Selecting four universities that offer entrepreneurial courses for engineering students (public and private universities). These included universities that offer compulsory courses, as well as universities that offer elective courses.

Step 4: Distributing the developed questionnaire to the graduate engineers from the four selected universities.

The questionnaire was developed based on the literature. To ensure the validity of the measurement instrument and thereby measuring what are supposed to be measured, the draft questionnaire distributed to a number of experts and then developed based on the received feedback, comments and suggestions. This was to ensure a high validity of questionnaire. Reliability was also tested and found to be high (Cronbach's Alpha = 0.876).

The population of the study consisted of twenty-five Jordanian public and private universities that

offer engineering programs. 92% of them (23 universities) offer compulsory or elective entrepreneurship courses for engineering students.

Secondary data were collected through a review of engineering curricula in the twenty-five Jordanian universities, to obtain the necessary information to answer the first question of the study (What is the percentage of Jordanian universities who offer entrepreneurial courses for engineering students?). The study analyze d engineering program curricula in Jordanian universities and identified which universities offer entrepreneurship programs for engineering students.

Based on the outcomes of the overview of the study plans for the twenty-five universities, four universities were selected for the purpose of survey. The reason for choosing the mentioned universities is that one of them (Al-Hussein Technical University) is the only university that offers the course as a compulsory course for engineering students while the other three universities selected (University of Jordan, Princess Sumaya University for Technology, and Al-Ahliyya Amman University) offer entrepreneurship course for engineering students as an optional university requirement. It is noted that there is a university in the sample (the only university in the study population) that offers the course as compulsory, so it would be possible to take advantage of it being mandatory and to test whether there are differences in the average "entrepreneurial engineer mindset" between this university and the rest of the three universities.

It is understood that a larger sample size would have been more representative of the population. Therefore, more than 200 questionnaires were distributed to engineering students who graduated between 2016 and 2022, but the responses did not exceed 100, of which 65 were valid for analysis. As well as taking into account the fact that, the sample size was large enough to provide meaningful results.

Primary data was collected using questionnaires distributed to engineering graduates from the four selected universities, to measure the role of undergraduate engineering students' entrepreneurship courses in the development of the "entrepreneurial engineer mindset" and then broadening their career horizons and opportunities. The collected primary data from engineering graduates helped in obtaining the necessary information to answer the other questions of the study.

The questionnaire included demographic questions (gender, university of undergraduate education, year of graduation, engineering major, and employment situation). It also included thirty-two questions to measure the knowledge and skills of entrepreneurship based on the entrepreneurial competencies identified in Bruce R. Barringer and R. Duane Ireland's book (Barringer & Ireland, 2018), perceptions of entrepreneurial engineering, and broadening job opportunities and prospects. The measurement scale consisted of a 5-point scale: "1" for very poor, "2" for poor, "3" for average and "4" for good, and "5" for very good.

The following hypotheses were developed and tested using appropriate statistical analysis techniques:

The first hypothesis: The level of knowledge and entrepreneurial skills of engineering graduates ranges from average to good.

The second hypothesis: There is a significant difference in the level of knowledge and entrepreneurial skills of engineering graduates between Al Hussein Technical University and the other three universities.

The third hypothesis: The responses of the engineering graduates reveal the mindset of the entrepreneurial engineer.

The fourth hypothesis: There is a statistically significant correlation between entrepreneurial knowledge and skills of engineering graduates and their entrepreneurial mindsets.

Data was collected and analyzed using the appropriate statistical analysis techniques. Data were analyzed using descriptive statistics (frequencies, mean and standard deviation). Hypotheses were tested using (t-test and correlation).

4. Findings

This study collected secondary data from the 25 Jordanian universities that offer engineering programs. It examined study plans and engineering curricula and found that 92% of Jordanian universities offer elective or mandatory courses in entrepreneurship for engineering students and only

Table 1 : Distribution of participants by gender

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Female	30	46.2	46.2	46.2
Male	35	53.8	53.8	100.0
Total	65	100.0	100.0	

8% of universities do not offer any elective or mandatory entrepreneurship programs for engineering students.

This research surveyed engineers to gain a better understanding of their demographic information. The results in Table 1 showed that there was an equal distribution of male and female participants.

Table 2 : The distribution of participants according to the university from which they graduated

University	Frequency	Percent	Valid Percent	Cumulative Percent
Princess Sumaya University for Technology	15	23.1	23.1	23.1
Al-Hussein Technical University	9	13.8	13.8	36.9
Al-Ahliyya Amman University	22	33.8	33.8	70.8
The University of Jordan	19	29.2	29.2	100.0
Total	65	100.0	100.0	

The distribution of participants by year of graduation shown in Table 3. The majority of engineering graduates (more than 75%) were recent graduates in 2020 and beyond. Therefore, their knowledge, skills, and perceptions of entrepreneurship were new.

Table 3 : the distribution of participants by year of graduation

	Year of graduation	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2022	6	9.2	9.2	9.2
	2021	31	47.7	47.7	56.9
	2020	12	18.5	18.5	75.4
	2019	9	13.8	13.8	89.2
	2018	1	1.5	1.5	90.8
	2017	2	3.1	3.1	93.8
	2016	4	6.2	6.2	100.0
	Total	65	100.0	100.0	

The distribution of participants by engineering major is shown in Table 4. More than a third of the respondents were civil engineers and the remainder were from other engineering disciplines.

Table 4: The distribution of participants by engineering major

Engineering Major	Frequency	Percent	Valid Percent	Cumulative Percent
Civil Engineering	22	33.8	33.8	33.8
Mechanical Engineering	8	12.3	12.3	46.2
Electronics/ Electrical Engineering	2	3.1	3.1	49.2
Computer Engineering	2	3.1	3.1	52.3
Power and Energy Engineering	10	15.4	15.4	67.7
Architectural Engineering	7	10.8	10.8	78.5
Industrial Engineering	1	1.5	1.5	80.0
Communications Engineering	2	3.1	3.1	83.1
Mechatronics Engineering	3	4.6	4.6	87.7
Software Engineering	8	12.3	12.3	100.0
Total	65	100.0	100.0	

The distribution of participants according to their employment status is shown in Table 5. The employment status question is very important to understand if the engineers who are answering the questions have working experiences and are able to answer the questions regarding the relationship between entrepreneurial knowledge and getting better job opportunities and having wider career prospects. Employed in their engineering major answers represented 44.6% of the study sample, which gives a better indication for the questions regarding engineers having extra skills (marketing, sales, management…) helps engineers get better job offers and positions. Having only 4% as self-employed gives an indication that engineering graduates do not have enough skills and knowledge to be able to start their own businesses, thinking that starting a business needs partners coming from business backgrounds to fill in their gap in business knowledge.

About 67% of the participants enrolled in the entrepreneurship course offered by Jordanian universities as an optional requirement for all students. More than 86% of respondents indicated that this course is not enough to build knowledge on how to be an entrepreneurial engineer. This leads to the conclusion that although engineers obtain some of their knowledge from the courses offered, the courses offered are not sufficient to build a solid foundation of the entrepreneurial knowledge needed to tackle the

Table 5 : The distribution of participants according to their employment status

Which best describes your employment situation

	Frequency	Percent	Valid Percent	Cumulative Percent
Employed (In your engineering major)	29	44.6	44.6	44.6
Employed (Outside your engineering major)	15	23.1	23.1	67.7
Unemployed	17	26.2	26.2	93.8
Self-employed (Started a small business)	4	6.2	6.2	100.0
Total	65	100.0	100.0	

rapidly emerging engineering industry. About 99% of respondents agreed that having an entrepreneurship course for engineers, as a mandatory requirement for all engineering students would be of greater value.

The set of entrepreneurial knowledge and skills included in the questionnaire was developed based on the literature. Participants' responses to these entrepreneurial knowledge and skills shown in Table6 . As shown in the table, most of entrepreneurial knowledge and skills ranged from poor to average for the following relevant aspects: capturing market needs, feasibility analysis, writing a business plan, entrepreneurial finance, and managing innovation projects. While most of them ranged from average to good for the remaining relevant aspects.

Table 6 : Participants' responses to entrepreneurial knowledge and skills

Entrepreneurship Knowledge & Skills	Very Poor	Poor	Average	Good	Very Good
Entrepreneurship and innovation	1.5%	15.4%	47.7%	20.0%	15.4%
Capturing market needs	1.5%	29.2%	33.8%	24.6%	10.8%
Feasibility analysis	4.6%	24.6%	49.2%	16.9%	4.6%
Writing a business plan	0.0%	27.7%	43.1%	23.1%	6.2%
Teamwork and leadership skills	3.1%	9.2%	21.5%	41.5%	24.6%
Marketing	3.1%	20.0%	23.1%	33.8%	20.0%
Entrepreneurial finance	13.8%	26.2%	38.5%	18.5%	3.1%
Managing innovation projects	1.5%	30.8%	30.8%	21.5%	15.4%
Communication skills	4.6%	10.8%	20.0%	36.9%	27.7%
Problem-solving	4.6%	1.5%	20.0%	40.0%	33.8%
Planning and Strategic thinking	3.1%	4.6%	16.9%	43.1%	32.3%
Engineering technical skills	1.5%	1.5%	30.8%	47.7%	18.5%
Industry research	6.2%	12.3%	36.9%	27.7%	16.9%
Product development	9.2%	16.9%	40.0%	24.6%	9.2%
Strategic business development	10.8%	24.6%	33.8%	24.6%	6.2%

Table 7 : Descriptive statistics (the skills and knowledge of entrepreneurship)

Descriptive Statistics

	N	Mean	Std. Deviation
Entrepreneurship Knowledge & Skills	65	3.3600	0.67452
Valid N (list wise)	65		

Descriptive statistics related to the skills and knowledge of entrepreneurship are shown in Table 7. The mean of entrepreneurial knowledge and skills is closer to average than to good.

Outputs of one-sample t test shown in Table VIII. As shown in Table 8, sig. (2-tailed) = 0.099, which is not significant. This indicates that the mean of entrepreneurship knowledge and skills of engineering graduates ranged from average to good. Therefore, the first hypothesis is accepted.

Table 8 : Outputs of one-sample t-test (entrepreneurship knowledge & skills)

One-Sample Test

Test Value = 3.5

	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference Lower	Upper
Entrepreneurship Knowledge & Skills	-1.673	64	0.099	-0.14000	-0.3071	0.0271

Independent samples t-test was used to test the second hypothesis in terms of the existence of statistically significant differences in the level of entrepreneurship knowledge and skills of engineering graduates between Al-Hussein Technical University (where the business entrepreneurship course is compulsory) and the other three universities (where the business entrepreneurship course is elective). Outputs of independent samples t-test shown in Table 9. This indicates that there is significant difference in the level of entrepreneurial knowledge and skills of engineering graduates between Al Hussein Technical University and the other three universities. Therefore, the second hypothesis is accepted. This result is expected and logical, as Al-Hussein Technical University offers the entrepreneurship course as a mandatory course with a practical nature, while other universities offer it as an elective course.

Engineers were asked about their source of entrepreneurial knowledge; they had the ability to choose multiple sources of knowledge. As shown in Figure 1, the main source of entrepreneurial

Table 9. Outputs of independent samples t-test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Entrepreneurship Skills	Equal variances assumed	4.224	0.044	-0.231	63	0.818	-0.04622	0.20006	-0.44600	0.35356
	Equal variances not assumed			-0.291	36.395	0.772	-0.04622	0.15864	-0.36784	0.27540

knowledge and skills for engineering graduates is university courses followed by entrepreneurship programs and workshops, then practical experience working with startups and finally participation in entrepreneurship competitions. Having undergraduate courses, as one of the main courses, is a positive indication of the potential that these courses can bring to undergraduate engineering students.

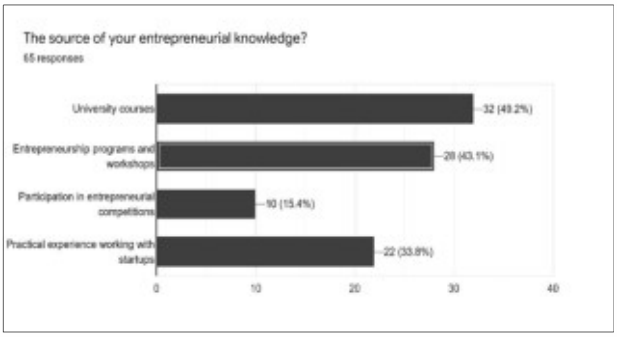

Table 9 : Outputs of independent samples t-test

The set of questions included in the questionnaire was developed based on the literature. Participants' responses to the perceptions of entrepreneurial engineering are shown in Table 10. As shown in the table, about 50% of them answered "yes" to the question "Do you have a business idea in engineering?" 60% to the question "Have you ever tried to start your own small business?" and more than 80% for all remaining questions.

Table 10 : Perceptions of entrepreneurial engineering (self-designed questions)

Perceptions of Entrepreneurial Engineering	Yes	No
Do engineers make successful entrepreneurs?	84.6%	15.4%
Are engineering education and entrepreneurship related?	87.7%	12.3%
Does knowledge in business and entrepreneurship open opportunities for engineering graduates?	90.8%	9.2%
Do you think that education in entrepreneurship and business management has helped you find a job?	83.1%	16.9%
Have you ever tried to start your own small business?	60.0%	40.0%
Do you have a business idea in engineering?	50.8%	49.2%
Do you have the ability to turn an engineering idea into a viable business?	76.9%	23.1%
Are you interested in working with a startup company, to learn additional skills?	86.2%	13.8%
Do you aspire to start your own engineering business?	84.6%	15.4%
If you intend to start a business, do you need additional business education?	84.6%	15.4%

Descriptive statistics related to the entrepreneurial engineer mindset are shown in Table 11. The average mindset of an entrepreneurial engineer is closer to "yes" than to "no."

Table 11 : Descriptive statistics related to the entrepreneurial engineer mindset

Descriptive Statistics	N	Mean	Std. Deviation
Entrepreneurial Engineer Mindset	65	1.8000	0.17139
Valid N (list wise)	65		

Outputs of the one-sample t-test are shown in Table 12. As shown in the table, sig. (2-tailed) = 0.000, which is significant. This indicates that the responses of the engineering graduates did not reveal the mindset of the entrepreneurial engineer. Therefore, the third hypothesis is rejected.

Table 12 : Outputs of one-sample t-test (entrepreneurial engineer mindset)

One-Sample Test						
	Test Value = 2					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Entrepreneurial Engineer Mindset	-9.408	64	0.000	-0.20000	-0.2425	-0.1575

Table 13 : Correlation test results (entrepreneurship knowledge & skills, entrepreneurial engineer mindset)

Correlations			
		Entrepreneurship Knowledge & Skills	Entrepreneurial Engineer Mindset
Entrepreneurship Skills	Pearson Correlation	1	0.314*
	Sig. (2-tailed)		0.011
	N	65	65
Entrepreneurial Engineer Mindset	Pearson Correlation	0.314*	1
	Sig. (2-tailed)	0.011	
	N	65	65

*. Correlation is significant at the 0.05 level (2 -tailed).

About 94% of the participants think that having entrepreneurial skills as an addition to your engineering knowledge will broaden their career horizons and opportunities. They also think that engineering graduates with additional skills (management, marketing, sales....) can get better job offers. More than 92% of respondents believe that adding an entrepreneurship course for engineers as a mandatory requirement will help graduates get more career opportunities and broader career prospects.

Correlation test results are shown in Table 13. Correlation coefficient = 0.314 and the sig. (2-tailed) = 0.011, which indicates that there is a statistically significant positive correlation between the knowledge and skills of entrepreneurship and entrepreneurial engineer mindset. Therefore, the fourth hypothesis is accepted.

5. Discussion

Based on the findings of this research, 92% of Jordanian universities offer courses related to entrepreneurship. Only 4% offer compulsory and intensive entrepreneurship program for engineering students, while 88% offer elective courses related to entrepreneurship, offered for all undergraduate students. This study gives a positive indicator about the level of the entrepreneurial knowledge and skills the engineering graduates have. Level of knowledge and skills in entrepreneurship is explored to be between average and good, which led to accepting the first hypothesis.

The research also sheds light on the relationship between knowledge of entrepreneurship, getting more career opportunities and having broader career prospects. This study leaves us with an important conclusion that engineering graduates need a foundation of entrepreneurial knowledge and skills. Not only does this foundation of knowledge help engineers deal with the ever-growing industry, but it has also been proven through this study that it helps in getting a better job opportunity that expands job horizons and that engineering graduates need the knowledge and skills in entrepreneurship to get broader career prospects, and to get more of employment opportunities.

The study sample of 65 engineers agreed that having an "engineering entrepreneurship course" would be a positive addition to their undergraduate engineering learning journey. Developing entrepreneurial knowledge, skills, and motivation is considered as the key factor to paving new career paths for engineers. The research focused on identifying the impact of blended programs or engineering curricula reinforced with entrepreneurship education, on graduates and on their future choices and opportunities. The main impact examined was the change in attitude in considering entrepreneurship as a career path. The survey showed how students who did not participate in their undergraduate years in any entrepreneurial courses or programs prefer to work in government jobs or in large companies because they specialize only in their specific engineering field.

The students who participated in the programs and courses were more motivated to start and lead their own businesses as well as to work in small or medium enterprises where they can learn a lot about different disciplines and roles, making them more knowledgeable and well-prepared to lead various innovative engineering projects.

Exposure to such education helps in exploring the mindset of creating something new, flexibility, and independence when it comes to opening a small business to meet a need in the market (Duval-Couetil et al., 2012). Integrating entrepreneurship education into engineering curricula can contribute to creating a creative learning environment where students learn about business, finance, marketing, and many other valuable knowledge. Hence, this helps the students to bridge the gap in business knowledge, which they feel may be their weakness and the reason for their lack of confidence in starting their own business.

Recently, entrepreneurship education has gradually begun to develop in Jordanian universities. Elite universities started adding such courses as a potential complement to business education, followed

by the rest of the universities, adding entrepreneurship courses as an option in the university's elective requirements. When these adjustments started to take place in the Jordanian universities, it was still unclear whether these programs will increase student's actual entrepreneurship knowledge and skills, and if it is going to change the economy or the jobs provided by companies for fresh graduates.

The findings of this research suggest that universities should consider offering more intensive and compulsory entrepreneurship courses for engineering students in order to equip them with the necessary knowledge and skills to become successful entrepreneurs. Furthermore, universities should also focus on developing the mindset of the entrepreneurial engineer in order to help engineering graduates expand their job opportunities and prospects. Finally, universities should also consider providing more resources and support for engineering graduates to help them develop their entrepreneurial knowledge and skills.

6. Conclusion And Recommendations

This study focused on a series of analyze s to find out if there is a relationship between providing entrepreneurial education, exploring the 'entrepreneurial engineer mindset,' and thereby widening engineers' job opportunities and career prospects. The conclusion reached by the analysis series is that there is a positive relationship between entrepreneurial skills and mindset.

Although engineering graduates have highlighted undergraduate courses as one of their main sources of knowledge, there are some pieces missing for engineers during their undergraduate years in regards to the courses offered. These available classes are incompatible with today's engineering world's needs for entrepreneurial knowledge.

Collectively, these findings begin to get an idea of how closely the two fields (entrepreneurship and engineering) are related. This idea is supported by many researchers with previous research conducted globally, and this study comes to support the idea of the relationship between engineering and entrepreneurship to build new and innovative engineering projects in Jordan as well as around the world.

Improve existing courses and change them into mandatory requirements, to get to the point where they form the well-built foundation of entrepreneurial knowledge and develop the entrepreneurial engineer mindset needed to think freely and outside the box when it comes to an engineer's career opportunities and prospects. As well as starting contacts and directions with engineering professors about the link between the two fields and the importance of consolidating the concept of entrepreneurship in all engineering courses and topics. Educating future engineers with a solid engineering education and the right entrepreneurial knowledge, will benefit them and put them ahead of the engineering game today.

Several indicators show that there is a dire need for engineers with skills and knowledge in the field of entrepreneurship because today's growing environment is full of market competitiveness and business pressure, making innovation and entrepreneurship among the key factors of today's engineering world.

The study concluded that it is necessary for engineering undergraduates to get the proper entrepreneurial education to be able to correlate it with their engineering major, which results in thinking wider towards their engineering career and future opportunities, as well as being able to compete in today's innovative and fast emerging engineering industry.

Finally, suggesting a general framework for engineering curricula in Jordanian universities, providing a new, practically useful approach to how to set up engineering curricula when combined with the concept of entrepreneurship and the mindset of the entrepreneurial engineer.

7. Study Limitations And Future Research

One of the limitations of this study is that it relied on the perceptions of university graduates engineers during recent years about entrepreneurial knowledge and skills. In addition to the relatively small size of the sample that was analyze d, although it is statistically appropriate and its results can be generalized to the study population. The real challenge was in distributing questionnaires during the period of the Corona epidemic. This is in addition to the fact that the subject of entrepreneurship is relatively new to Jordanian universities. Study plans in the vast majority of universities classify it as elective subjects, and only one university classifies it as compulsory.

It is suggested that studies be conducted on the extent to which entrepreneurship concepts, practices and skills are included in the curricula of academic programs and courses in universities at the graduate and undergraduate levels.

References :

[1] Akpochafo, G. O., & Alika, I. H. (2018). Perceived Impact of Entrepreneurship Education on Career Development among Undergraduates in South-South Universities in Nigeria: Implication for Counselling. Journal of Education and Learning, 7(3), 102-108.

[2] Baciu, E. L., Vîrgă, D., & Lazăr, T. A. (2020). What Characteristics Help Entrepreneurs 'Make It'Early on in Their Entrepreneurial Careers? Findings of a Regional Study from Romania. Sustainability, 12(12), 5028.

[3] Barba-Sánchez, V., & Atienza-Sahuquillo, C. (2018). Entrepreneurial intention among engineering students: The role of entrepreneurship education. European research on management and business economics, 24(1), 53-61.

[4] Bruce R. Barringer, B. R., & Ireland, R. D. (19018). Entrepreneurship: Successfully Launching New Ventures. 6th edition. 9781292255330. Pearson.

[5] Blake Hylton, J., Mikesell, D., Yoder, J. D., & LeBlanc, H. (2020). Working to instill the entrepreneurial mindset across the curriculum. Entrepreneurship Education and Pedagogy, 3(1), 86-106.

[6] Bosman, L. & Fernhaber, S. (2018). Teaching the entrepreneurial mindset to engineers. Switzerland: Springer International Publishing.

[7] Byers, T., Seelig, T., Sheppard, S., & Weilerstein, P. (2013). Its role in engineering education. The Bridge, 43(2), 35-40.

[8] Cheng, Y. M., Wang, K., & Lee, I. K. (2018). Application of engineering education in entrepreneurship construction system. Eurasia Journal of Mathematics, Science and Technology Education, 14(6), 2185-2191.

[9] Dao, C. T. (2018). A proposal for improving entrepreneurship education for engineering students in Vietnam. Review of Integrative Business and Economics Research, 7, 12-19.

[10] Duval-Couetil, N., Reed-Rhoads, T., & Haghighi, S. (2012). Engineering students and entrepreneurship education: Involvement, attitudes and outcomes. International Journal of Engineering Education, 28(2), 425.

[11] Holzmann, P., Hartlieb, E., & Roth, M. (2018). From Engineer to Entrepreneur-Entrepreneurship Education for Engineering Students: The Case of the Entrepreneurial Campus Villach. International Journal of Engineering Pedagogy (IJEP), 8(3), 28-39.

[12] Huang-Saad, A., Bodnar, C., & Carberry, A. (2020). Examining current practice in engineering entrepreneurship education. Entrepreneurship Education and Pedagogy, 3(1), 4-13.

[13] KritiKoS, A. S. (2014). Entrepreneurs and their impact on jobs and economic growth. IZA World of Labor.

[14] Karim, M. S. A. (2016). Entrepreneurship education in an engineering curriculum. Procedia Economics and Finance, 35, 379-387.

[15] McGrath, R. G., & MacMillan, I. C. (2000). The entrepreneurial mindset: Strategies for continuously creating opportunity in an age of uncertainty (Vol. 284). Harvard Business Press.

[16] Newport, C. L., & Elms, D. G. (1997). Effective engineers. International Journal of Engineering Education, 13(5), 325-332.

[17] Rodrigues, R. G., Dinis, A., do Paço, A., Ferreira, J., & Raposo, M. (2012). The effect of an entrepreneurial training programme on entrepreneurial traits and intention of secondary students. Entrepreneurship–Born, made and educated, 77-92.

[18] Rodriguez, J., Chen, H. L., Sheppard, S., Leifer, L., & Jin, Q. (2015). Exploring the interest and intention of entrepreneurship in engineering alumni. In 2015 ASEE Annual Conference & Exposition (pp. 26-738).

[19] Roy, N., Schlosser, F., & Pasek, Z. (2020). Stimulating entrepreneurial interest in engineers through an experiential and multidisciplinary course collaboration. Entrepreneurship Education and Pedagogy, 3(1), 14-40.

[20] Saral, H., & Alpkan, L. (2019). Differences in Entrepreneurial Intention and Characteristics according to Demographics and Other Factors.

[21] Shekhar, P., & Huang-Saad, A. (2021). Examining engineering students' participation in entrepreneurship education programs: implications for practice. International Journal of STEM Education, 8(1), 1-15.

[22] Treanor, L. (2012). Entrepreneurship education: Exploring the gender dimension: A gender and enterprise network, hea sponsored, discussion workshop. International Journal of Gender and Entrepreneurship.

[23] Vesper, K. H., & Gartner, W. B. (1997). Measuring progress in entrepreneurship education. Journal of Business venturing, 12(5), 403-421.

[24] Vij, V., & Ball, S. (2010). Exploring the impact of entrepreneurship education on university nonbusiness undergraduates. International Journal of Entrepreneurship and Small Business, 9(1), 86-109.

[25] Vodă, A. I., & Florea, N. (2019). Impact of personality traits and entrepreneurship education on entrepreneurial intentions of business and engineering students. Sustainability, 11(4), 1192.

[26] Wood, M. T., Gadd, K., & Falkenburg, D. (2004). Entrepreneurship for engineers. In VentureWell. Proceedings of Open, the Annual Conference (p. 131). National Collegiate Inventors & Innovators Alliance.