

## Entrepreneurial skills according to principles of entrepreneurial education among chemistry department students at the faculty of education for pure sciences, Ibn Al-Haytham

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**Abstract:** The aim of the current research is to identify the degree of availability of entrepreneurial skills according to the principles of entrepreneurial education among the students of the Chemistry Department at the Faculty of Education for Pure Sciences, Ibn Al-Haytham. The research adopted a descriptive research approach, and the sample consisted of 100 male and female students from the fourth-year Chemistry Department for the academic year 2024–2025, both in the morning and evening sessions, representing 75% of the community, selected randomly. The research tool was an entrepreneurial skills scale based on the principles of entrepreneurial education, consisting of 30 items distributed across six skill areas: personal skills, thinking skills, technological and technical skills, social skills, practical skills, and administrative skills. Using the Statistical Package for the Social Sciences (SPSS-22), the results showed that entrepreneurial skills based on entrepreneurial education principles are available among the Chemistry Department students at the Faculty of Education for Pure Sciences, Ibn Al-Haytham. The research recommended several suggestions, including renewing the role of universities to transform into entrepreneurial universities capable of equipping students with the knowledge and skills necessary to become entrepreneurs capable of meeting the ever-evolving demands of the labor market. Additionally, it recommended training teaching staff on how to adopt and promote entrepreneurial thinking and education principles, thus enhancing entrepreneurial skills among students. The research also suggested further studies on the impact of academic programs in universities on acquiring entrepreneurial skills among students.

**Keywords:** Chemistry, Entrepreneurial education principles, Entrepreneurial skills, Faculty of education for pure sciences, Technological skills, University students.

### 1. Introduction

Entrepreneurial education refers to all activities aimed at developing labor market skills, such as self-initiated project establishment and striving for sustainability, which yields returns for the individual [1]. There is growing interest in developing entrepreneurial skills among university students by instilling the principles of entrepreneurial education, which means enhancing job opportunities that align with the demands of the modern labor market. Entrepreneurial education works to develop entrepreneurial knowledge, attitudes, and skills. Studies confirm that students exposed to entrepreneurial learning experiences are better prepared for work and more successful in establishing their own ventures [2].

Entrepreneurial education is considered one of the most successful experiences in higher education programs, aiming to make education contribute to preparing students for self-employment and project

establishment. As a result, more than 1,600 colleges and universities in the United States offer entrepreneurship programs [3]. Traditional educational systems emphasize providing vast amounts of information, covering it, and focusing on memorization processes, often delivering information disconnectedly, leading to a gap in achieving desired goals [4]. Therefore, one of the justifications for using entrepreneurial education in university education is its essential role in preparing a generation of students trained in numerous skills and knowledge required by the information society, relying on the concept of entrepreneurship to adopt projects that influence the trajectory of societies, thereby contributing to progress and advancement. Additionally, technological education is increasingly emphasized in the information age, which underpins the economic system [5]. Consequently, educational institutions strive to adapt and develop teaching methods to equip students with entrepreneurial skills across various professional fields that meet labor market needs and enable students to achieve their ambitions and handle their future roles [6].

Furthermore, it allows students to use modern technologies in education, thereby developing entrepreneurial skills that suit the evolving labor market environment [7] acquiring skills for coexisting with others, and adapting to role changes in professional life [8]. This signifies a shift in the role of university education from focusing on employment to emphasizing the principle of creating job opportunities, graduating students capable of preparing and providing job opportunities for themselves and future generations, thereby enhancing social and economic development in society. This is achieved through the innovative processes initiated by entrepreneurial students in all fields they will work in the future [9].

Spreading a culture of entrepreneurship and encouraging students to embrace it is currently a top priority for global universities. This is achieved by modifying and developing academic programs and incorporating specialized courses in entrepreneurship. Most universities have moved toward integrating entrepreneurship into educational programs and embedding entrepreneurial activities in educational contexts, adopting self-directed and project-based learning strategies. Consequently, the role of universities is shifting from focusing on employment to emphasizing the principle of creating job opportunities [10].

On this basis, entrepreneurial education is viewed as an educational process aimed at building values and skills that help students broaden their perspectives in their studies and subsequent work opportunities, in addition to utilizing behavioral and personal activities and attitudes related to career planning [11]. Therefore, it is essential to incorporate entrepreneurship education into universities through various training programs and by integrating it into curricula and teaching methods [12].

In the same context, Researcher emphasized that integrating entrepreneurship is a key factor in the university education stage, as it contributes to development and reduces graduate unemployment [7]. Researchers explain that entrepreneurial education plays a role in developing students' entrepreneurial skills by adopting programs aligned with entrepreneurial educational goals, focusing on the quality of content and programs rather than their quantitative aspects. This means emphasizing the acquisition of fundamental skills such as communication, risk-taking, decision-making, critical and analytical thinking, teamwork, and initiative.

Educational literature highlights that the most prominent entrepreneurial skills university graduates should possess include the ability to (visualize, imagine, initiate, think critically, analyze logically, use induction and deduction to make decisions, think independently, contribute to positive change, formulate hypotheses and models, simulate, communicate and interact with others based on their values, concepts, and aspirations, work collaboratively in interdisciplinary teams, engage in continuous learning to keep up with changes in knowledge and technology, and generate and apply information in the form of services and goods) [13].

Meanwhile, Al Shobaki and Naser [14] classified entrepreneurial skills into three types: personal entrepreneurial skills, which include (creativity and innovation, responsibility and risk-taking, leadership, and perseverance); business management skills, which include (planning, marketing and

sales, negotiation, decision-making, and finance); and technical skills, which include (communication, utilizing and leveraging technology, networking, and environmental monitoring and scanning) [14].

In the same context, Shaker and Ghaleb, classified entrepreneurial skills into five categories: personal skills, thinking skills, technical and technological skills, social skills, and practical skills [13].

Numerous classifications of entrepreneurial skills have emerged in educational literature and previous studies, as this concept varies depending on the environments and needs of each society and its culture. In this research, six entrepreneurial skills will be adopted, namely (personal, thinking, technical, technological, social, practical, and managerial skills). These can be described as follows:

**Personal Skills:** Personal skills can be acquired through learning, and the social environment plays a significant role in shaping a student's personality and their way of interacting with society. Among the most prominent are (responsibility and risk-taking, leadership, initiative and perseverance, and focus on end goals) [15].

**Thinking Skills:** These skills help develop students' creative ideas, enabling them to connect with their surrounding environment, which prepares them to become future entrepreneurs. These skills include (achievement motivation, future vision, negotiation, proactive behavior, creativity and innovation, critical and analytical thinking, among others) [16].

**Technical and Technological Skills:** These skills enable students to work with computers, create websites, and handle communication and information technologies. Key skills include (communication, utilizing and leveraging technology, networking, and environmental monitoring and scanning) [14].

**Social Skills:** Socially entrepreneurial students constantly seek new opportunities and create a positive impact using leadership and management methods. This requires the development of several social aspects, such as (respecting different opinions, appreciating cultural differences, conflict management and negotiation, and teamwork) [10].

**Practical Skills:** These represent the practical abilities entrepreneurial students need to effectively apply knowledge and ideas in various work environments. These skills include (project management, effective leadership, effective communication with colleagues, negotiation, and overcoming work obstacles).

**Managerial Skills:** These skills include (goal setting, planning, implementation, evaluation, decision-making, and problem-solving) [17].

## 2. Research Problem

Amid the transformation of higher education institutions to adapt and develop teaching methods to meet labor market needs and empower university students to handle their future roles and achieve their ambitions by equipping them with entrepreneurial skills through the integration of entrepreneurship into university education programs, the issue of the role of education colleges emerges. One of their educational objectives is to align their outputs with the requirements for employment in the teaching profession at secondary schools, rather than focusing on graduating students capable of securing job opportunities. Consequently, students tend to rely on the state to provide jobs instead of embracing the concept of self-employment. This reflects a shortcoming in supporting entrepreneurial education and equipping students with the necessary entrepreneurial skills for effective and efficient teaching. Therefore, this research seeks to deepen the understanding of entrepreneurial skills based on the principles of entrepreneurial education by addressing the question: To what extent are entrepreneurial skills, per the principles of entrepreneurial education, available among chemistry department students at the College of Education for Pure Sciences/Ibn Al-Haytham?

## 3. Research Objective

The research aims to identify the degree to which entrepreneurial skills, per the principles of entrepreneurial education, are available among chemistry department students at the College of Education for Pure Sciences/Ibn Al-Haytham. This will be achieved by answering the following questions:

1. Is there a statistically significant difference at the significance level (0.05) between the mean scores of the research sample students and the hypothetical mean on the entrepreneurial skills scale?
2. Is there a statistically significant difference at the significance level (0.05) between the mean scores of the research sample students and the hypothetical mean for each skill on the entrepreneurial skills scale?

### 3.1. Research Limits

The research limitations are:

- Human Limits: Fourth-year students (morning and evening studies).
- Time Limits: The academic year (2024–2025).
- Spatial Limits: College of Education for Pure Sciences – Ibn Al-Haytham / University of Baghdad / Chemistry Department.

### 3.2. Definition of Terms

Entrepreneurial Skills: Defined by the 'Partnership for 21<sup>st</sup> Century Skills Partnership for 21<sup>st</sup> Century Learning [18] as a set of skills that students need in various work environments, enabling them to be active, productive, and creative members, aligning with the economic development requirements of the 21<sup>st</sup> century. These are considered 21<sup>st</sup>-century skills [18].

Procedural Definition of Entrepreneurial Skills: A set of skills that should be available among the students in the research sample, enabling them to prepare and create job opportunities for themselves and future generations, thereby enhancing social and economic development in society. These skills include (personal, thinking, technical and technological, social, practical, and managerial skills), measured by the scale designed for this purpose."

### 3.3. Entrepreneurial Education

Shane and Venkataraman [19] defined it as "a set of systematic educational patterns to train and educate students through various development programs. These programs include raising awareness about the importance of entrepreneurship and establishing and developing micro-business projects. Such educational methods give students various entrepreneurial skills and encourage them to learn, innovate, and build self-confidence [19].

### 3.4. Operational Definition of Entrepreneurial Education

Educational and training patterns and entrepreneurial activities target the students in the research sample, enabling them to learn, innovate, and transform creative ideas into entrepreneurial ventures." Methodology

A descriptive research approach was adopted to identify the degree to which entrepreneurial skills, per the principles of entrepreneurial education, are available among chemistry department students at the College of Education for Pure Sciences/Ibn Al-Haytham.

### 3.5. Research Community and Sample

The research community consisted of all fourth-year students in the chemistry department, including both morning and evening study programs. The total number of students was 133, comprising 66 male students (50%) and 67 female students (50%). Due to the small size of the community, Stephen Thompson's formula was applied using Microsoft Excel to determine the sample size. Based on this, a simple random sampling method was used to select a sample of 100 students.

### 3.6. Research Instrument

After reviewing previous research, studies, and educational literature related to this topic, a specialized scale for measuring entrepreneurial skills based on the principles of entrepreneurial education was developed for this research. The following steps were followed:

**Defining the Scale's Objective:** The scale aims to measure the degree to which entrepreneurial skills, per the principles of entrepreneurial education, are available among chemistry department students at the College of Education for Pure Sciences/Ibn Al-Haytham.

**Defining the Scale's Domains:** Six domains of entrepreneurial skills were identified based on the principles of entrepreneurial education: (personal skills, thinking skills, technical and technological skills, social skills, practical skills, and managerial skills). The scale consisted of 30 items, with 5 items allocated to each of the six domains.

The scale used a three-point Likert scale (often, sometimes, and rarely), with item scores ranging from 3 to 2 to 1. The total score for the scale ranged between 30 and 90, with a hypothetical mean of 60. Experts in teaching methods and chemistry verified the scale's face validity. Using the Chi-square test, it was found that the calculated values for all items were significant than the tabulated value of 3.84 at a significance level of 0.05 and with 99 degrees of freedom.

**Statistical Analysis of the Scale Items:** After applying the scale to the statistical analysis sample of 100 students, the following analyses were conducted:

**Internal Consistency Validity (Construct Validity of the Scale):** It was found that all correlation coefficients were more significant than the tabulated value of (0.195) at a significance level of (0.05) and with 99 degrees of freedom. Table (1) illustrates the correlations between each domain and the other domains of the entrepreneurial skills scale based on the principles of entrepreneurial education.

**Table 1.**  
Correlations Between Each Domain and the Other Domains of the Entrepreneurial Skills Scale Based on the Principles of Entrepreneurial Education.

The Scale as a Whole	Administrative Skills	Practical Skills	Social Skills	Technological and Technical Skills	Thinking Skills	Personal Skills	Domains
1						1	Personal Skills
					1	0.572	Thinking Skills
				1	0.228	0.280	Technological and Technical Skills
			1	0.297	0.326	0.325	Social Skills
		1	0.359	0.294	0.566	0.270	Practical Skills
	1	0.294	0.251	0.357	0.440	0.315	Administrative Skills
	0.228	0.357	0.307	0.561	0.602	0.226	The Scale as a Whole

The table indicates a positive correlation between item scores and the overall scale score. Additionally, the relationship between each item's total score and the total score of the domain is statistically significant. It also shows that the correlation between each domain and the overall scale score is statistically significant.

### 3.7. Discriminatory Power of the Scale Items

A t-test for two independent samples was conducted to measure the difference between the mean scores of each item in the scale across the two groups. When comparing the calculated t-values with the tabulated t-value (1.98) at a significance level of (0.05) and a degree of freedom (98), it was found that the calculated t-values for all items were greater than the tabulated t-value, indicating statistical significance, meaning the items were distinctive.

### 3.8. Scale Reliability

Two methods were used to assess reliability

1. Cronbach's Alpha Method: The overall reliability of the scale was (0.81). The reliability coefficients for the different domains (personal skills, thinking skills, technical and technological skills, social skills, practical skills, and managerial skills) were (0.79 – 0.82 – 0.80 – 0.82 – 0.80 – 0.78), respectively. These values indicate a reliable scale.
2. Split-Half Method: Pearson's correlation coefficient was calculated between the two halves of the test items. After applying the Spearman-Brown correction formula, the overall reliability of the scale was found to be (0.80). The reliability coefficients for the domains (personal skills, thinking skills, technical and technological skills, social skills, practical skills, and managerial skills) were (0.81 – 0.77 – 0.78 – 0.80 – 0.82 – 0.81), respectively, indicating good reliability.

**Table 2.**

Reliability Table of the Entrepreneurial Skills Scale According to the Principles of Entrepreneurial Education.

Domains	Reliability Coefficient (Cronbach's Alpha)	Reliability Coefficient (Half Split)
Personal Skills	0.79	0.81
Thinking Skills	0.82	0.77
Technological and Technological Skills	0.80	0.78
Social Skills	0.82	0.80
Practical Skills	0.80	0.82
Administrative Skills	0.78	0.81
Overall Scale	0.81	0.80

#### 4. Results and Discussion

First Research Question: *Is there a statistically significant difference at the 0.05 significance level between the mean scores of the research sample students and the hypothetical mean on the entrepreneurial skills scale?*

Using the one-sample t-test, the mean score was found to be (71.69) with a standard deviation of (6.66).

**Table 3.**

Mean, Standard Deviation, and t-Value for a One-Sample Test on the Entrepreneurial Skills Scale According to the Principles of Entrepreneurial Education.

Variables	No. items	Sample	Standard deviation	Arithmetic mean	Hypothetical mean	T- value		Significance
Entrepreneurial Skills	30	100	6.66	71.69	60	Calculated	Tabular	0.05
						17.52	1.98	

From Table 3 it is evident that the calculated t-value (17.52) is significantly higher than the tabulated t-value (1.98) at the 0.05 significance level. When comparing the mean score of the research sample (71.69) with the hypothetical mean (60), a statistically significant difference in favor of the mean score was found. This indicates that the students in the research sample possess entrepreneurial skills at an acceptable level according to the principles of entrepreneurial education.

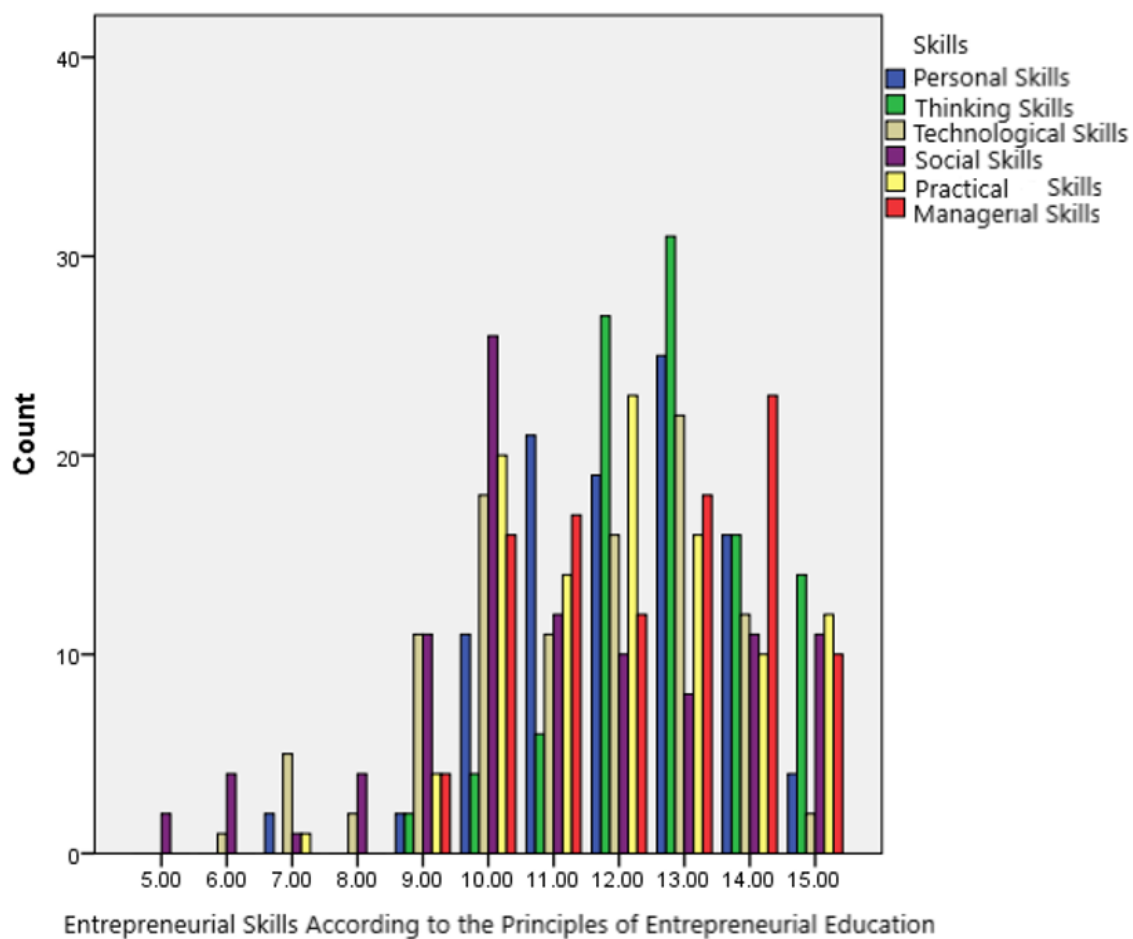
Second Research Question: *Is there a statistically significant difference at the 0.05 significance level between the mean scores of the research sample students and the hypothetical mean for each skill in the entrepreneurial skills scale?*

Using a one-sample t-test for each skill separately, all calculated t-values were greater than the tabulated t-value (1.98) at the 0.05 significance level, as shown in Table 4.

**Table 4.**  
One-Sample t-Test Results for Entrepreneurial Skills According to the Principles of Entrepreneurial Education.

Skills	Arithmetic mean	Standard deviation	Hypothetical mean	T- Value	Tabular value	Significance
Personal Skills	12.10	1.61	10	13.03	1.98	Sig.
Thinking Skills	12.85	1.38	10	20.64		Sig.
Technological and Technical Skills	11.33	2.05	10	6.47		Sig.
Social Skills	11.07	2.48	10	4.30		Sig.
Practical Skills	12.01	1.79	10	11.19		Sig.
Managerial Skills	12.33	1.75	10	13.25		Sig.

From Table 4 it is evident that all skills were statistically significant, and their availability was at a high level. The descending order of skills from highest to lowest was as follows: Thinking Skills, Managerial Skills, Personal Skills, Practical Skills, Technical and Technological Skills, and Social Skills.



**Figure 1.**  
Mean Scores of Entrepreneurial Skill.

The statistical results indicate that the students in the research sample possess entrepreneurial skills according to the principles of entrepreneurial education as a whole. This can be attributed to the fact that the students demonstrate relatively high entrepreneurial skills, which can be explained by the following factors:

- The effectiveness of course content, modern teaching methods, and practical training incorporated into the academic program. The adoption of educational strategies such as project-based learning, collaborative learning, teamwork, initiative-taking, problem-solving-based learning, decision-making, critical and analytical thinking plays a crucial role in enhancing entrepreneurial education skills. These approaches foster creativity and innovation among students. Supporting this interpretation, emphasized that adopting communication, risk-taking, decision-making, critical and analytical thinking, teamwork, initiative-taking, and knowledge of available resources contributes to creating new projects and significantly aids in developing entrepreneurial skills [20, 21].
- The college supports individual talents and creativity, as well as organizes festivals and activities that encourage innovation and recognition of outstanding students.

The statistical results indicate that the students in the research sample possess entrepreneurial skills across all individual skill domains. The ranking of these skills, based on their mean scores, is as follows:

- Thinking Skills ranked first, with a mean score of (12.85) and a t-value of (20.64). The high mean score for this skill indicates the development of critical and creative thinking among students, which helps them make decisions and solve problems in entrepreneurial ways. Additionally, teaching methods such as problem-based learning and case studies may have contributed to developing these skills.
- Managerial Skills ranked second, with a mean score of (12.33) and a t-value of (13.25). This suggests that students possess good managerial skills, indicating their readiness to manage projects, set goals, and organize resources efficiently. Furthermore, the use of management simulations, feasibility studies, and training in strategic planning may have played a role in enhancing these skills.
- Personal Skills ranked third, with a mean score of (12.10) and a t-value of (13.03). This result suggests that students have a high level of personal skills, such as communication abilities, self-confidence, teamwork, and self-learning, which are essential for entrepreneurial success. This could be attributed to group activities, presentations, and personal skills training as part of the course content.
- Practical Skills ranked fourth, with a mean score of (12.01) and a t-value of (11.19). This indicates that students can convert knowledge into practical application, a key aspect of entrepreneurial education. Practical training, real-world projects, and field visits have likely contributed to developing these skills.
- Technical and Technological Skills ranked fifth, with a mean score of (11.33) and a t-value of (6.47). This indicates that students possess good technical skills, but they are relatively lower than the previously mentioned skills. This may be due to the limited use of technology and available resources, as well as insufficient integration of technology in education through e-learning and interactive applications to enhance these skills.
- Social Skills ranked sixth, with a mean score of (11.07) and a t-value of (4.30). Although teamwork was encouraged during laboratory experiments and report writing, there was less emphasis on broader social interaction and leadership training, which could have helped strengthen these skills.

## 5. Conclusions

Based on the research findings, the following conclusions were reached:

- The research sample students possess entrepreneurial skills, indicating that the college has significantly contributed to equipping them with these skills.
- Thinking skills were the most prevalent among students, followed by managerial, personal, practical, and technical and technological skills, while social skills were the least prevalent.



## 6. Recommendations

- Integrate entrepreneurial education into course content and related activities to strengthen the fundamentals and principles of entrepreneurial project management, aligned with educational institutions' goals.
- Redefine the role of universities to become entrepreneurial institutions capable of equipping students with the knowledge and skills necessary to become entrepreneurs who can adapt to the evolving demands of the job market.
- Train faculty members on adopting and promoting entrepreneurial thinking and entrepreneurial education principles among students to help develop their entrepreneurial skills.
- Organize training workshops to prepare and qualify students by designing academic programs and plans that align with job market needs and industry developments.
- Utilize the experiences of developed countries in the field of entrepreneurship and entrepreneurial education.
- Link university education with job market requirements by providing comprehensive educational programs that enhance students' ability to meet the evolving skills demands of the workforce.
- Enhance the practical aspect of learning and increase technology integration in education through e-learning and interactive applications to strengthen these skills. Expand practical training in technical and technological skills through workshops and vocational training.
- Focus on developing social skills by providing training in leadership, teamwork, and collaborative learning approaches.

## 7. Suggestions for Future Research

- Conduct studies on the level of entrepreneurial skills among university faculty members.
- Examine the impact of academic programs in universities on students' acquisition of entrepreneurial skills.

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**Appendix 1.**

Entrepreneurial Skills Scale Based on the Principles of Entrepreneurial Education.

<b>Entrepreneurial Skills</b>	<b>Items</b>
Personal Skills	I take risks when making decisions about my future.
	- I face challenges and difficulties to ensure success in the tasks I undertake.
	- I take my time to judge different ideas and viewpoints.
	- I convince my team members of my decisions when working in a group.
	- I come up with multiple solutions to problems I encounter in my academic life.
Thinking Skills	I propose a range of alternatives to solve a problem and make decisions to choose the best one.
	I recognize the strengths and weaknesses in any task I perform.
	- I understand situations and events and express them in a way that makes the unclear understandable
	I look for ways to help me accomplish my work with a degree of excellence
	I develop old ideas in any task I perform into new ideas.
Technical and Technological Skills	- I use a computer and its software, such as presentation tools (PowerPoint), word processing (Word), and spreadsheet software (Excel).
	- I use the internet efficiently..
	- I employ artificial intelligence applications, like Knewton and DreamBox, to solve problems.
	- I interact with various online platforms to access information.
	- I communicate effectively with others using technological innovations, such as voice recordings, images, files, and educational links
Social Skills	I address community issues and contribute to solving them.
	I work more effectively within a team than when working alone.
	I work as a team player with others and encourage them to exchange ideas and knowledge to complete tasks.
	I initiate actions to gain support, influence others, and convince them.
	I negotiate and discuss issues with others to solve unresolved problems.
Practical Skills	I use information technology to manage and execute tasks and projects.
	I apply concepts, facts, and theories to solve problems in new situations.
	- I interpret and deduce conclusions to arrive at generalizations that can be applied.
	I use well-studied scientific methods when executing any task or project.
	I set precise scientific criteria for monitoring the implementation of business plans when requested.
Managerial Skills	- I rely on scientifically studied methods when performing any task.
	- I monitor the implementation of plans based on sound scientific principles.
	- I delegate tasks among my team members to complete the required work with minimal time, effort, and cost.
	- I rely on scientific procedures when making decisions and solving problems, starting from goal setting to evaluation.
	- I assess any task from its beginning to its completion by identifying strengths and weaknesses in all stages of plan execution.