

# CRITICAL THINKING EDUCATION IN THE DEVELOPMENT OF ENTREPRENEURIAL INTENTIONS IN SCIENCE STUDENTS, CAIRO UNIVERSITY CASE STUDY

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## ABSTRACT

*Recent work on the subject has confirmed that critical thinking skills are among the most important skills for developing students' personalities, rendering them capable of entrepreneurship, and to avoiding problems that have a direct and negative impact on society and the economy. This study evaluated the ability of the science students studying at Cairo University with respect to entrepreneurship in relation to quantitative measurements of their critical thinking skills. To achieve this aim, the authors used a prepared questionnaire consisting of four sets of questions, where each set included five questions. The four sets evaluated students' effective thinking skills, problem solving skills, entrepreneurship skills, and relationships between thinking and entrepreneurship. With 300 male and female students, a quantitative research methodology was applied. The authors used the IBM-SPSS software to analyze the collected data. The results reflect the importance of this study for critical thinking among science students, indicating a significant impact on their attitudes regarding their acquisition of entrepreneurial skills. It was concluded that if today's students are to become entrepreneurs of tomorrow, they must learn to think critically, as this will help them evaluate their opportunities. These findings will be of interest to policymakers, practitioners, and researchers who are working to shape the entrepreneurial intent of university students.*

**Keywords:** Critical Thinking, Business, Entrepreneurship Education, Skills, Cairo University.

## INTRODUCTION

As part of a project to develop the Egyptian mind, the Supreme Council of Universities (SCU) approved, 2 years ago, an initiative by Cairo University to require new students to take two new courses, Critical Thinking and Entrepreneurship. SCU has recommended a generalization of this experience to other Egyptian universities to create a rising generation with greater awareness and enhanced development and to develop students' skills that can be transferred from a theoretical scope of study to practical experience of students.

The main idea that distinguishes higher education from other forms is the application of critical thinking. The need for critical thinking has been observed in relation to different perspectives and goals, all of which tend toward the concept of a dynamic and healthy economy and society. Healthy democracies require critical thinkers capable of assimilating complex issues. To be properly performed, critical thinking depends on a quality of thinking that affects the quality of life and seeks to learn how to continually improve it. Critical thinking skills are

vital for moving from an industrial society to one in which workers make increasingly complex decisions at work and must deal with the pace and magnitude of changes in technology. It has become a skill that pioneers require in businesses to think clearly about their projects, make sound decisions, and convince customers to buy their products and investors to invest in their work. Critical thinking is important for improving work and solving problems: by its means, entrepreneurs can learn to identify the foundation on which a project will be built and carefully sort out its success. They will also be able to address many questions, such as the following: Is there a demand for my product or service? How can my project be financed? Where should its workplace be? What are my long-term goals? Should I seek a patent? Who are my competitors? Critical thinking can clarify the answers and make them more accurate and objective. Sometimes, entrepreneurs require investors to participate in their projects, which entail an effort to convince and impress the investor. An intelligent investor will ask an entrepreneur difficult questions, so it is very important to prepare convincing logical answers, developed using critical thinking, following these guiding questions: What are the reasons that the investor will find convincing? What things does an investor want to hear? What is your potential market size? Who is competing with your product or service? Do you have intellectual property rights? Who makes up the working group? What have your funding sources been so far? Think about what will convince the investor to invest in your organization. Building this argument with the tools entails persuading the other to accept your point of view, and the argument includes premises and results; in the foreground are the reasons from that persuasion leads another to accept the result, which is the point of view that is presented. Before this begins, however, the entrepreneur must determine who he wishes to convince, which client or investor. Arguments are based on facts, not feelings. Among the obstacles to critical thinking, the most prominent are myths, fanaticism, strong feelings, and bias toward what you know against what you do not know, as this weakens the objectivity of the presentation, observation, and analysis, which leads to erroneous decision making. The evidence that entrepreneurs use to persuade others must be free from logical fallacy or gimmicks. Entrepreneurs can observe the problems facing people from all sides using their critical thinking, which can lead them to develop a theory that they can implement in a solution through an unconventional idea that grows into pi critical thinking in the business education pioneering project that they are working on, making decisions for the future and facing problems, analyzing them and their potential challenges.

### **Critical thinking and Twenty-First Century Skills**

The term twenty-first century skills have become a central topic of interest to researchers in education and economics in particular, as these disciplines depend on these skills being able to help their students live better in a new, rapidly changing world Saleh (2019).

These skills are grouped into a range of categories, among the most prominent of which are educational skills, such as critical thinking, problem solving, communication and cooperation, and creativity and innovation; following these are the digital skills, which include informational, media, and technology skills; and finally, we have the professional and life skills, including flexibility and ability of adaptation, initiative and self-direction, social and cultural interaction, productivity, and leadership and responsibility Baron & Sternberg (1987). Researchers have found that instruction in twenty-first century skills must be inside schools or universities because it is difficult for students to learn them outside Halpern (2013).

Hence, critical thinking is a core academic skill and a vital necessity of the twenty-first century in particular; students must be trained well to deal with the huge amount of information that we are receiving in this era Halpern (2003). Critical thinking helps us think more clearly about what affects the quality of life and indicates how we can continually improve Din (2020).

### **Critical thinking and Vision 2030**

Setting aside all previous definitions of twenty-first century skills and division into groups, the vision of the world in the coming years, the so-called Vision 2030, focuses on critical thinking skills, self-learning, and effective communication Sarigoz (2012). The most important challenge the implementation of Vision 2030 is facing is the difficulty of providing instruction and evaluation for the skill of critical thinking; thus, it must first be ensured that the students have the ability to understand, apply, analyze, and evaluate, as well as perform other high-level skills Shaughnessy (2012). Therefore, guidance to plan well and meticulously and develop curricula to become able to develop these skills with the preservation of the content is the aim of this all-educational strategic plan.

Strategies developed for learning twenty-first century skills have focused on developing the curriculum to bring it into close relation with students' lives, identifying the disciplines and skills related to each other, enhancing creativity and generating ideas, and building new languages of understanding between a scientific subject and students to develop all skills, especially higher-order thinking skills. The researchers emphasized that project-based learning is the best and easiest way to acquire these skills, using discussion, inquiry, cooperation, communication, and problem solving in the context of what are called work teams Bell (2010). This helps us to think more clearly in relation to the rapid flow of large amounts of information produced, thanks to the rapid progress of science and technology, and to differentiate between factual and fake information Paul (2005).

### **Critical thinking in Entrepreneurship Education**

It is appropriate to begin the results section with studies that indicate the importance of critical thinking in Entrepreneurship Education (EE). This would clarify how critical thinking becomes embedded in EE in terms of its operation in class documents, subject guides, and course materials. The literature identifies critical thinking as an important part of a set of skills that need to be bedded in EE. To think critically and to learn critically are often seen as a single important skill that every business student should have. Preceptors and scholars are encouraged to look at critical thinking as part of discipline-specific literacy issues and to consider its use as an enabling tool when supported by an orientation in business that bears results. The researchers believe that several vital traits are developed in entrepreneurship students where critical thinking is embedded in the course, such as intellectual modesty, intellectual courage, intellectual empathy, intellectual integrity, intellectual perseverance, intellectual faith in reason, and intellectual fair-mindedness. They also believe that the critical thinking effect on the entrepreneurship education through it come to design a solution approach through a process of considering the available information, identifying alternatives, and integrating evidence, reason, and values and finally form a clear conclusion Celuch & Slama (1999); Springer & Borthick (2004).

They likewise claim that critical thinking should not be considered a thinking tool among others (e.g., as a type of higher-order thinking skill) without taking the experiences and the

environment that can foster it into account (Varela et al., 2005). They suggest that learning environments should be altered to suit the twenty-first workplace to develop both creative and critical thinking skills, i.e., a more practice-orientated end. Others find that critical thinking has a more applied focus as we, e.g., some suggest that it can be used in peer education or for promoting lifelong learning Borthick & Schneider (2016); Dehler et al. (2001); Bejinaru (2018).

The impact of critical thinking on EE has shifted from an assumed, rather generalized, and unformed benefit to a more realistic focus in terms of addressing real-world issues and businesses Mingers (2000); Barnett (1997). Recent cases have indicated that EE should incorporate critical thinking to improve managerial practices Bell & Loon (2015) and students' employability (Dehler et al., 2001) or to resolve pressures between proposition and practice Barnett (2007); Garcia (2009). Furthermore, critical thinking in EE has been seen to be useful as a lens with which to discuss ethics in the classroom, and it helps promote discussion around managing tensions between business and the public interest (Hummel et al., 2018) More recently, the entrepreneurship literature associates critical thinking with ethical thinking and judgments or with moral misconduct in business (Liu et al., 2014). However, clearly, the perceived focus of critical thinking in EE is more closely focused and realistic in the confines of advanced education.

## RESEARCH METHODOLOGY

### Aim of the Study

This study evaluates the critical thinking skills of science students that help them succeed in entrepreneurship and in life through the evaluation of the following objectives:

1. Problem solving by following a systematic method.
2. Organizing and absorbing important information.
3. Visualizing, analyzing, monitoring, and evaluating at a deeper level.
4. Objectively considering all available options and alternatives before making a decision.
5. Effective communication to find solutions to complex problems.
6. Determining the logical connections and correct methods of inference.
7. Moving away from one's beliefs and doing what is best for the task.
8. A real desire for success.
9. Identifying strengths and weaknesses in any field.
10. Taking the necessary steps to succeed in any field.

### Sample and Methods

A total of 300 male and female students studying in the second, third, and fourth years at the faculty of science of Cairo University in several disciplines participated in this questionnaire. To evaluate the respondents' critical thinking skills, the authors designed a questionnaire including four scales and 20 unique statements. The authors hypothesized that each statement corresponds to a skill that is important for predicting the level of critical thinking necessary for the field of entrepreneurship. The prototype questionnaire was examined by three scholars, and their opinions were taken into consideration in the final corrected version of the questionnaire, which was used for data collection to complete the author's objectives and outcomes.

## Questionnaire Design

After identifying what the questionnaire seeks to measure, the questionnaire included a welcome message and researcher information and the privacy and data protection details, followed by the demographic characteristic questions (i.e., gender, educational level, and academic concentration). Additionally, the questionnaire consists of four scales: effective thinking skills, problem solving skills, entrepreneurship skills, and link between thinking and entrepreneurship skills. The study computed the correlations between the questions and the skills as shown in Tables 1-11 and Figures 1-4.

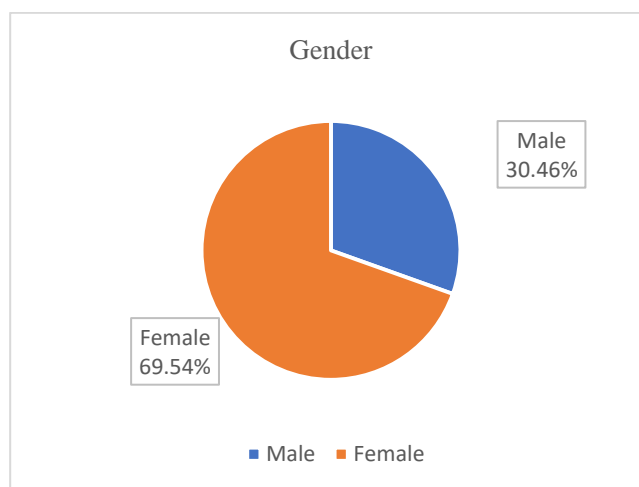
Each scale consisted of five closed-ended questions, mostly consisting of multiple-choice questions and linear scale questions that accepted answers on a 5-point Likert scale on which responders specified their level of agreement with a statement typically in 5 points (1= strongly disagree; 2= disagree; 3= neutral; 4= agree; and 5= strongly agree) to assess the students' critical thinking skills.

## RESULTS AND FINDINGS

In this section, we report the data collected by the prepared questionnaire after statistical analysis as described below.

### Demographic Profile

**Gender:** As seen in Figure 1, the majority of participants (210, 69.54%) in this sample were females. The study did not take the effect of gender on the critical thinking skills of the science students into consideration.



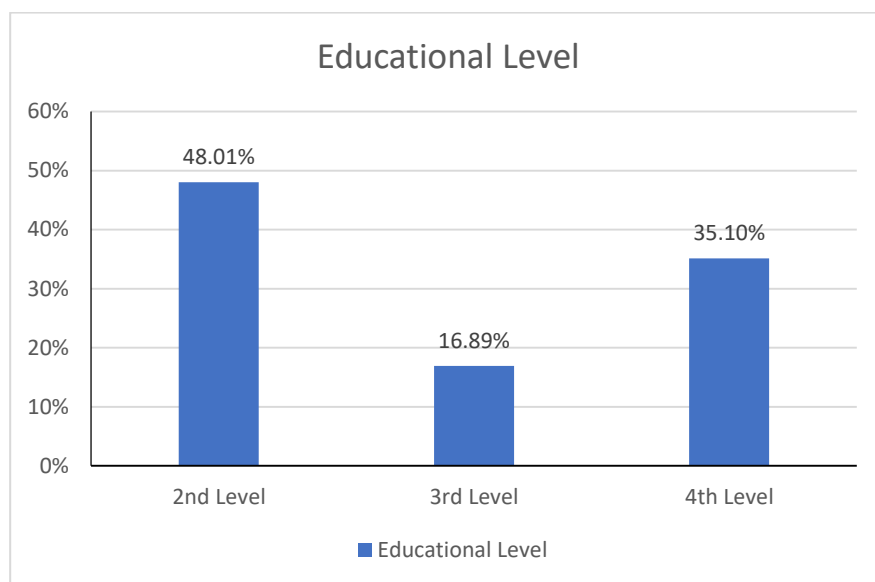
**FIGURE 1**  
**DISTRIBUTION OF PARTICIPANTS BY GENDER**

**Specialization:** Most of the participants (143, 47.35%) were majoring in chemistry, 81 (26.82%) were studying biotechnology, 51 (16.89%) had other specializations, 18 (5.96%) were studying special chemistry, three (0.99%) were concentrating on physics, three (0.99%) focused on computer science, two (0.66%) majored in physics, and one (0.33%) was studying biology, as

seen in Table 1. The present study does not consider the diversity of the participants on the basis of their specialty or its correlation with critical thinking skills.

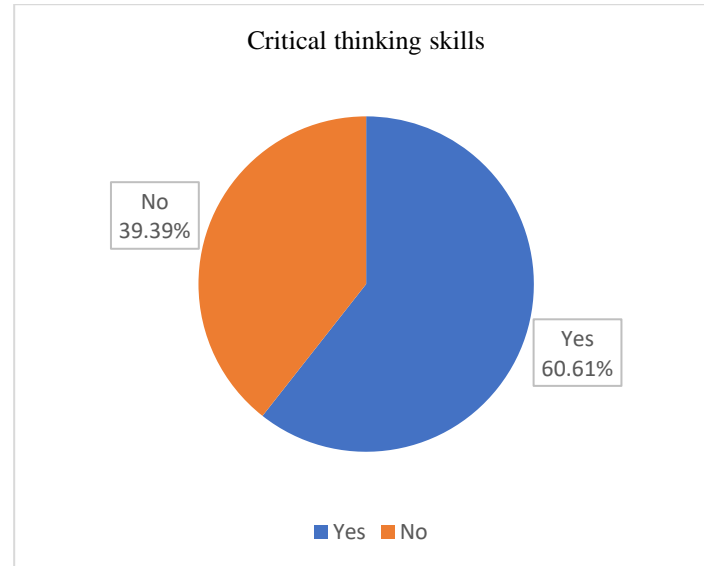
<b>Specialization</b>	<b>N</b>	<b>%</b>
Major Chemistry	143	47.35%
Biotechnology	81	26.82%
Other	51	16.89%
Special Chemistry	18	5.96%
Physics	3	0.99%
Computer Science	3	0.99%
Major Physics	2	0.66%
Biology	1	0.33%

**Educational level:** Most of the participants (145, 48.01%) were at the second studying level, 51 (16.89%) were at the third level, and 106 (35.10%) were at the fourth level. Although this study does not concentrate on the correlation between the academic level and critical thinking skills, the greater degree of participation among students from the second level who have studied the critical thinking course recently (at the first level) may have affected their answers, as we discuss below Figure 2.



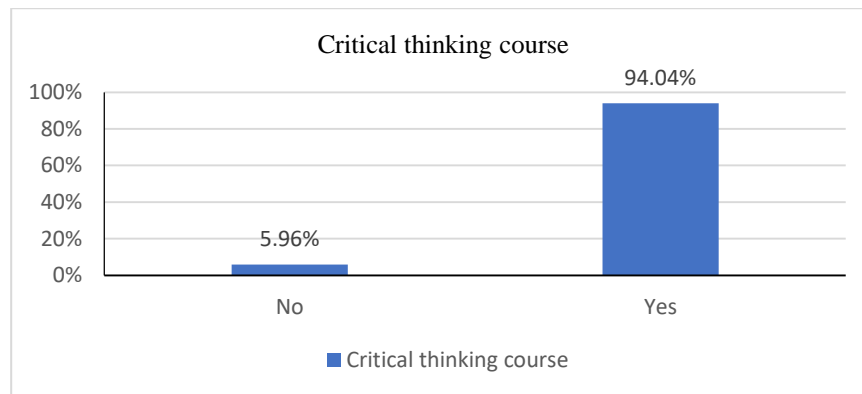
**FIGURE 2**  
**DISTRIBUTION OF PARTICIPANTS BY EDUCATIONAL LEVEL**

**Do you have an idea of critical thinking skills:** Among the students reporting having an idea of critical thinking skills, 278 participants (92.05%) said that they had critical thinking skills, and 24 (7.95%) said that they did not. This question-answer supports our previous result with the large participation of second-level students in the questionnaire Figure 3.



**FIGURE 3**  
**KNOWLEDGE OF CRITICAL THINKING SKILLS**

**Have you taken a course on critical thinking:** Most of the participants (284, 94.04%) reported having taken a critical thinking course and 18 (5.96%) reported that they did not Figure 4.



**FIGURE 4**  
**PERCENTAGE OF PARTICIPANTS WHO HAD TAKEN A CRITICAL THINKING COURSE**

### Validity Analysis

Table 2 illustrates the validity of the items and their scales in the questionnaire using Pearson's correlation coefficients; we find that all items are consistent with their dimensions. Because all items correlate with their scales at a 0.01 level of significance, we do not remove or change the position of any phrase.

<b>Scale</b>	<b>Items</b>	<b>Pearson's correlation coefficient</b>
<b>Effective thinking skills</b>	Statement 1	0.400**
	Statement 2	0.620**
	Statement 3	0.397**
	Statement 4	0.532**
	Statement 5	0.342**
<b>Problem solving skills</b>	Statement 1	0.585**
	Statement 2	0.440**
	Statement 3	0.554**
	Statement 4	0.361**
	Statement 5	0.373**
<b>Entrepreneurship skills</b>	Statement 1	0.502**
	Statement 2	0.469**
	Statement 3	0.397**
	Statement 4	0.637**
	Statement 5	0.542**
<b>Link between critical thinking and entrepreneurship skills</b>	Statement 1	0.494**
	Statement 2	0.454**
	Statement 3	0.472**
	Statement 4	0.568**
	Statement 5	0.433**

\*\*Correlation is significant at the 0.01 level (two-tailed)

### Reliability Analysis

As seen in Table 3, Cronbach's alpha ( $\alpha$ ) is calculated as 0.104, 0.109, 0.291, and 0.147 for the four scales, that is, effective thinking skills, problem solving, entrepreneurship skills, and the link between critical thinking and entrepreneurship, respectively, and the ( $\alpha$ ) total value is 0.510. The ( $\alpha$ ) low results are discussed below.

<b>Scale</b>	<b>No. of items</b>	<b>Cronbach's alpha (<math>\alpha</math>)</b>
Effective thinking skills	5	0.104
Problem solving skills	5	0.109
Entrepreneurship skills	5	0.291
Link between critical thinking and entrepreneurship skills	5	0.147
Total	20	0.510

### Likert Scale

Table 4 represents the weighted average of responses on a 5-point Likert scale to provide a more detailed interpretation of the result of the analysis of the questionnaire responses. Generally, a weighted average is more accurate than a simple average, and as the same scale was used for each item, the same values reflect similar ratings.



Likert scale	Interval	Difference	Description
1	1.00-1.79	0.79	Strongly disagree
2	1.80-2.59	0.79	Disagree
3	2.60-3.39	0.79	Neutral
4	3.40-4.19	0.79	Agree
5	4.20-5.00	0.80	Strongly agree

### Effective thinking Skills Regarding the Distribution of Participants Opinion

Table 5 shows the distribution of participants' responses on the effective thinking skills scale. It should be noted that the majority of the students commented that they agree or strongly agree with each statement. Conversely, the majority of the students marked strong disagreement with the fifth statement. This is examined in the discussion section.

	Statement		SD	D	N	A	SA
1	Adapting to changes due to emergencies gives you the strength necessary to face life.	N	3	3	5	170	121
		%	0.99%	0.99%	1.66%	56.29%	40.07%
2	All university students are fit to be entrepreneurs in the future if they are trained in all the skills of effective thinking.	N	7	89	43	132	31
		%	2.32%	29.47%	14.24%	43.71%	10.26%
3	Students should take responsibility for their decisions.	N	1	8	9	163	121
		%	0.33%	2.65%	2.98%	53.97%	40.07%
4	The use of the mobile phone anywhere when the transmission network is available was hypothesized by scientists assumed before its invention.	N	10	57	152	67	16
		%	3.31%	18.87%	50.33%	22.19%	5.30%
5	Loud self-expression forces others to respect a speaker's opinion.	N	195	88	6	11	2
		%	64.57%	29.14%	1.99%	3.64%	0.66%

	Statement		SD	D	N	A	SA
1	Dealing with complex problems in a simplified manner is an important criterion for solving problems.	N	5	21	12	167	97
		%	1.66%	6.95%	3.97%	55.30%	32.12%
2	Following the six hats method when discussing different alternatives for solving problems is useful for avoiding disagreements and sterile discussion.	N	0	7	129	139	27
		%	0.00%	2.32%	42.72%	46.03%	8.94%
3	Feelings and emotions about a job provide clues or keys to show how to deal with your problems.	N	14	124	21	132	11
		%	4.64%	41.06%	6.95%	43.71%	3.64%
4	Identifying the problem is the first step to solving any problem.	N	1	0	0	102	199
		%	0.33%	0.00%	0.00%	33.77%	65.89%
5	The choices of the appropriate solution to a problem depend on the results of evaluating the proposed solutions.	N	2	13	13	214	60
		%	0.66%	4.30%	4.30%	70.86%	19.87%

## Problem Solving Skills Regarding the Distribution of Participants' Opinions

Table 6 shows the distribution of students' opinions on the problem solving skills scale. It should be noted that the majority of the students indicated agreement and strong agreement with each statement.

## Entrepreneurship Skills Regarding the Distribution of Participants' Opinions

Table 7 shows the distribution of students' opinions about the entrepreneurship skills scale. It has been noted that the majority of the students indicated agreement and strong agreement with each statement except for the third statement, where they are disagreeing, and it is the correct answer as will be explained in the discussion section.

	<b>Statement</b>		<b>SD</b>	<b>D</b>	<b>N</b>	<b>A</b>	<b>SA</b>
1	Community entrepreneurship enhances the status of society and is linked to the voluntary sector, and its fields include poverty	N	3	9	46	177	67
		%	0.99%	2.98%	15.23%	58.61%	22.19%
2	Waste recycling projects are among the important projects	N	3	3	7	122	167
		%	0.99%	0.99%	2.32%	40.40%	55.30%
3	At the beginning of projects, we must focus on the quality of the product without taking into account the opinion of customers	N	68	193	8	26	7
		%	22.52%	63.91%	2.65%	8.61%	2.32%
4	If you have 8 hours to start any project, you will need 6 hours of it to plan	N	17	97	55	100	33
		%	5.63%	32.12%	18.21%	33.11%	10.93%
5	The Apple logo (representing a bitten apple) expresses creativity, simplicity, and beauty	N	2	41	60	168	31
		%	0.66%	13.58%	19.87%	55.63%	10.26%

	<b>Statement</b>		<b>SD</b>	<b>D</b>	<b>N</b>	<b>A</b>	<b>SA</b>
1	Estimation is one of the mechanisms used to determine the company's budget and financial future.	N	55	126	42	72	7
		%	18.21%	41.72%	13.91%	23.84%	2.32%
2	The emergence of applications such as WhatsApp for instant messaging significantly weakened the BlackBerry company's website.	N	3	31	100	126	42
		%	0.99%	10.26%	33.11%	41.72%	13.91%
3	When you follow the evaluation matrix technique to choose the most appropriate project for you among several projects, it is necessary to specify 3 main criteria to judge the appropriate choice.	N	2	9	106	165	20
		%	0.66%	2.98%	35.10%	54.64%	6.62%
4	Passion for reading the stories of successful pioneers, developing creativity skills.	N	3	14	7	193	85
		%	0.99%	4.64%	2.32%	63.91%	28.15%
5	People who tend to be emotionally and mentally flexible are the most successful in entrepreneurship.	N	3	13	23	173	90
		%	0.99%	4.30%	7.62%	57.28%	29.80%

## Link between Critical thinking and Entrepreneurship Skills

Table 8 shows the distribution of students' opinions on the link between thinking and entrepreneurship skills scale. It has been noticed that the majority of the participants commented that they agreed and strongly agreed with each statement, except for the first statement.

## DISCUSSION

### Scale 1: Effective Thinking Skills

Previous studies have found that critical thinking skills are difficult to teach and evaluate Csapo & Funke (2017). Therefore, the authors of the study carefully prepared the 20 statements of the questionnaire and five statements for each scale, as shown in Tables 5-8; these statements were assessed to estimate the critical thinking skills of the science students. The authors hypothesized that each statement corresponded to one of the effective thinking skills, as indicated in Table 9, such that statements 1,2,3,4, and 5 refer to adaptability, analytical skills, responsibility, logical thinking, and listening to and respecting the speaker's opinion, respectively, and we considered that students' answers indicated the level of their effective thinking.

Table 9 presents the ranking of each phrase according to the student's opinions; they strongly agreed with statements 1 and 3, were neutral about statements 2 and 4, and strongly disagreed with statement 5. The highest arithmetic mean averages,  $M= 4.33$  and  $4.31$ , were gained with statements 1 and 3, respectively. These results indicate that students have a good rate of adaptability and responsibility skills. Additionally, the moderate arithmetic mean average was calculated for statements 2 and 4 with  $M= 3.30$  and  $3.07$ , respectively, where the correct answers were disagree and agree, respectively. These results showed a moderate degree of analytical and logical thinking skills. The majority (approximately 94%) of the students strongly disagreed with the assertion that raising one's voice induces agreement among others in statement 5, with low averages ( $M= 1.47$ ) compatible with the minimum 5-point Likert scale of this study.

Observing the results from another point of view, we note that approximately 29.47% of students disagreed with statement 2, which refers to this percentage of the participants who have an analytical skill with a good rate. Approximately 50% of the students' participants were neutral on statement 4; this result indicated that half of the students did not have the logical skill to deal with the new information. Generally, the participants were neutral with respect to effective thinking skills with  $M3.30$ ,  $std.deviation = 0.385$ , and they needed additional training on logical and analytical thinking.

<b>Statement</b>	<b>Corresponding skill</b>	<b>Mean</b>	<b>Std. dev.</b>	<b>Rank</b>	<b>Trend</b>
<b>1</b>	Adaptability	4.33	0.660	1	Strongly agree
<b>2</b>	Analytical skills	3.30	1.071	3	Neutral
<b>3</b>	Responsibility	4.31	0.688	2	Strongly agree
<b>4</b>	Logic thinking	3.07	0.867	4	Neutral
<b>5</b>	Listening and respecting the speaker's opinion	1.47	0.767	5	Strongly disagree
Total		3.30	0.385		Neutral

## Scale 2: Problem Solving Skills

Problem solving skills are among the most important indicators of efficiency of thinking because they include a large amount of necessary life and educational skills Ead & Nasar (2021). As represented in Table 6, five statements were used to measure the problem solving skills to evaluate the depth of thought, respecting other people's opinions and creative thinking, avoiding emotional thinking, identifying the problem, and evaluating the alternative solutions, respectively. The students' answers reveal the level of their problem solving skills.

In this section of the questionnaire, given on a 5-point scale, the correct answer is strongly agreeing for statements 2,4, and 5 and strongly disagreeing for statements 1 and 3. Table 10 presents the ranking for each skill in relation to the opinions presented. We found that the students strongly agreed with statements 1 and 3, in opposition to the strongly disagree rating expected. The author hypothesized that the correct answer for both statements is disagree These results illustrated that the students could not differentiate between simplicity to do any work and thinking in a simple way at the difficult situation nor could they differentiate between the importance of feelings in human encounters and the harmfulness of feeling when making an important decision. These results may indicate that the students lack precision or have chosen their answers by chance, and both interpretations indicate weak critical thinking skills.

A large percentage of the students' answers (42.72%) are neutral with statement 2, whereas 46.03% agreed and only 8.94% strongly agreed. This means that the students do not consider the six hats technique to be the best brainstorming method to initiate creativity, generate ideas, and ensure all viewpoints style that covered to solve the problem correctly. Conversely, we noticed that statements 4 and 5 have the highest arithmetic mean average ( $M = 4.65$  and  $4.05$ ), or strongly agree, which means that the students correctly identified the necessary steps to solving problems.

Generally, the participants provided agreement with problem solving skills:  $M = 3.88$ ,  $std. deviatio = 0.373$ . They require more effort to develop their thinking on inexpert and emotional thinking.

Statement	Corresponding skill	Mean	Std. dev.	Rank	Trend
1	Depth of thinking	4.09	0.88	2	Agree
2	Respect other people's opinions and Creative thinking	3.62	0.68	4	Agree
3	Avoiding emotional thinking	3.01	1.09	5	Neutral
4	Identifying the problem	4.65	0.52	1	Strongly agree
5	Evaluate the alternative solutions	4.05	0.69	3	Agree
Total		3.88	0.373		Agree

## Scale 3: Entrepreneurship Skills

The simple definition of entrepreneurship is the ability to turn ideas into action, taking the ability to resist expected and unexpected risks Ead & Fadlallah (2021); Creswell & Miller (2000). The authors prepared five statements represented in Table 7 to measure entrepreneurship skills presented in Table 11, to test the hypothesis. Table 11 includes understanding new social activities skills, understanding traditional projects, business management skills, strategic

thinking skills, and respecting the difference between people where they are corresponding to statements 1,2,3,4, and 5, respectively. The best answer is strongly agreeing for statements 1, 2, 4, and 5, and strongly disagrees for statement 3.

In the students' opinions, we found that the highest percentage of agreement and mean average (both agree or strongly agree) were identified with statements 1 (70%), 2 (95%), 4 (43%), and 5 (65%), and the highest percentage of disagreement and mean average (combining disagree or strongly disagree) were observed with statement 3 (85%). According to these results, the students have weak strategic skills, where 32.12% of the students disagree with statement 4 and 18.21% are neutral with the same statement. We note that as seen in Table 7, approximately 15.23% of the students expressed neutrality with respect to statement 1 and 19.87% were neutral with respect to statement 5; these results refer that the students need more training to understand more about the new social activities and improve their creativity skills. Generally, the participants agreed with the entrepreneurship skills with  $M = 4.45$ , std.deviation = .453, where they had the suitable percentage of entrepreneurship skills.

Statement	Corresponding skill	Mean	Std. dev.	Rank	Trend
1	Understanding new social projects	3.98	0.76	2	Agree
2	Understanding traditional projects	4.48	0.69	1	Strongly Agree
3	Business management skills	2.04	0.90	5	Disagree
4	Strategic thinking skills	3.12	1.14	4	Neutral
5	Respect the difference between people	3.61	0.87	3	Agree
Total		3.45	0.453		Agree

#### **Scale 4: Link between Critical thinking and Entrepreneurship Skills**

To elucidate the relationship between critical thinking and entrepreneurship, we linked critical thinking skills with some entrepreneurship issues, such as project budgets, real causes of company failure, decision making, successful entrepreneurs' stories, resilience, and the success in entrepreneurship through five hypothesized statements. These statements were prepared by the authors and are represented in Table 8, including ineffective thinking and project budgeting (1), identifying the real causes of company failure (2), scientific methods for decision making (3), passion for successful pioneer stories (4), and resilience and entrepreneurship success (5). The correct answer for statements 2, 3, 4, and 5 is strongly agreed and strongly disagree for statement 1.

Table 8 presents the rank for each phrase according to students' opinions; we found that the highest percentage of agreement (both agree or strongly agree) is observed with statements 2 (45%), 3 (60%), 4 (91%), and 5 (87%). Conversely, the highest percentage of disagreement (both disagree or strongly disagree) was observed with statement 1 (60%).

Table 12 indicates that the lowest mean average ( $M=2.50$ ) was recorded with ineffective thinking, and this result indicates that 23% of students tended to think emotionally regarding project budgets, which are the most critical elements in entrepreneurship. We also denote that the skill of passion for successful pioneer's stories had the first rank with ( $M=4.14$ ) with a percentage of 63.91%, which indicates that the students believed in the importance of success stories in attracting attention and enhancing their skills. Conversely, the intermediate mean averages ( $M=3.57$ ) and ( $M=3.64$ ) were noted to identify the real causes of company failure and

scientific methods for decision making, respectively. These results indicate that approximately 35% of the students required more training to apply scientific methods in response to failure and in decision making. Generally, the students agreed with a summary of the link between critical thinking and entrepreneurship skills with  $M = 3.59$ , std. deviation = 0.408, which means that the intermediate level of critical thinking skills of the students affects their entrepreneurship skills.

<b>Statement</b>	<b>Corresponding skill</b>	<b>Mean</b>	<b>Std. dev.</b>	<b>Rank</b>	<b>Trend</b>
1	In effective thinking in project budget	2.50	1.11	5	Disagree
2	Identifying the real causes of company failure	3.57	0.89	4	Agree
3	Scientific methods for decision making	3.64	0.68	3	Agree
4	Passion for successful pioneer stories	4.14	0.75	1	Agree
5	Resilience and success in entrepreneurship	4.11	0.79	2	Agree
Overall		3.59	0.408		Agree

### **Validity and Reliability Analysis**

The Pearson correlation coefficient was used to calculate the numerical values that are presented in Table 6 to predicate the validity scale, which helps evaluate the association or correlation level between the four scales of the present questionnaire and the items of each scale. These values refer to the relationship between the critical thinking skills of students and their effects on the students' ability to the field of entrepreneurship. Based on this method, the zero value indicates no correlation. For the present unique study, the correlation coefficient value exceeds 0.3 and ranges up to 0.6, which means that a positive relationship exists between the constituents of the present questionnaire at a significance level of 0.01. For social and educational studies, since we could not control the variables that affect the opinion of the student participants and had a sample that was limited to 300 students, the validity coefficients that ranged from 0.342 to 0.637 had moderate validity Springer & Borthick (2004); Al-Shammari & Waleed (2018).

Table 3 presents the reliability analysis, which allowed us to identify additional information about the properties of each item on each scale, which composes the questionnaire and the relationships between them. The total alpha value (0.510) indicated a suitable confidence of the present novel test. Meanwhile, the lower alpha value of each scale refers to no duplication or redundancy present in the test; it also refers to the lack of internal consistency in the statements. These results are acceptable because the study is novel, and the statements used in the questionnaire design were based on the vision of the authors, and similar studies must be conducted with different samples to attain a high level of validity and reliability (Daud et al., 2018).

## **CONCLUSION**

Entrepreneurship represents an appropriate field for implementing critical thinking, and our novel study succeeded for the first time in evaluating the critical thinking skills of science students and their readiness for entrepreneurship in relation to their previous study of critical thinking and entrepreneurship in the courses approved by the Cairo University Council as

required courses for all new students, beginning in 2019. We prepared a new questionnaire to assess and achieve 10 objectives: problem solving skills using systematic methods, organizing and absorbing important information, the ability to visualize, analyze, monitor, and evaluate at a deeper level, objectively considering all available options and alternatives before making a decision, promoting effective communication to find solutions to complex problems, determining logical connections and correct methods of inference, moving away from beliefs and doing what is best for work, developing the real desire for success, identifying one's strengths and weaknesses in any field, and taking the necessary steps to succeed in any field. The hypothesized objectives were divided across four scales, namely, critical thinking skills, problem solving ability, knowledge of entrepreneurship skills, and critical thinking skills in entrepreneurship issues. Each scale consisted of five statements, where the total questionnaire consisted of 20 statements, and each statement corresponded to one skill. By improving the methods of assessment of critical thinking skills, we could change the mindset of the students toward entrepreneurship. We analyzed the collected data of questionnaire by IBM SPSS, and the following features for science students were as follows:

1. Adaptability, responsibility, and leadership are strong skills.
2. Students' analytical and logical thinking skills are weak.
3. 50% of the students have weak strategic thinking and planning skills.
4. 23% of the students prefer emotional thinking.
5. 35% of the students need more training to apply the scientific methods at the failed and decision making.
6. 90% of the students have the passion to learn from the stories of successful entrepreneurs.
7. The students should study social projects and improve their creativity skills.

The authors recommend that to obtain a high level of validity and reliability, similar studies should be conducted in other different students' samples.

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