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# The Impact of Non-Formal Educational Approach on the Academic Performance and Employability of Engineering and Computer Science Students

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**Abstract.** Education is no longer a one-time event due to the quick changes in the modern world, the diversity of knowledge it contains, and the ongoing need for personal growth. It turns into a dynamic process that happens all through life. The old curricula and systems of formal education are finding it difficult to keep up with the quick changes occurring in the field of computer science. Non-formal education is a solution to the requirements of the era and can be implemented through seminars, training camps and workshops. It could be additional activities like competitions or extracurricular learning. The aim for this study is to investigate the impact of the non-formal educational approaches on engineering and computer science students' academic performance as well as their chances to obtain a job after graduation.

**Keywords:** non-formal education, academic performance, employability.

## 1. Introduction

Education is an essential component of human development, shaping people, societies, and nations. For decades, education has been considered as a transformational force, allowing people to gain the knowledge, skills, and attitudes required for personal development, economic growth, and improvements in society.

Education is not about sitting in classrooms and recollecting facts. It's not about texts or tests. Education focuses on developing critical thinking and problem-solving skills. Education encourages the ability to face real-world difficulties by stimulating curiosity, analysis, and innovation.

In 2015, the United Nations (UN) adopted a set of 17 goals as a universal call to action to end poverty, protect the planet, and ensure that people will enjoy peace and prosperity by 2030. These 17 goals are the Sustainable Development Goals (SDGs). The SDGs place priority on education because of its ability to empower individuals,

encourage sustainable development, and promote a more just and equitable world. According to the UN website, education is the key that will allow many other SDGs to be achieved. When people are able to get quality education they can break from the cycle of poverty.

### 1.1. *Types of Education: Informal, Formal, Non-Formal*

According to the International Commission on the Development of Education (commonly known as the Faure Commission) which was established by UNESCO in 1972, education was classified into three categories: formal, non-formal, and informal education (International Commission..., 1972).

- **Formal Education** refers to the highly institutionalized, systematically graded, and hierarchically structured "education system," which extends from primary school to the upper levels of university.
- **Non-Formal Education** is any organized educational activity performed outside the formal educational system to give specific types of learning to certain groups of people, including adults and children.
- **Informal Education** is a lifelong process in which individuals gain and accumulate knowledge, skills, attitudes, and insights through daily experiences and exposure to the environment at home, work, play, family, and friends.

The rapidly changes in the world of technology with its diversified nature of knowledge and constant need for personal development, education is no longer a one-time event. It becomes a dynamic process that occurs throughout life. Formal education, with its traditional structures and curricula, is struggling to keep up with the rapid pace of change in the computer science world.

On the other hand, Non-formal education empowers individuals to have lifelong learning throughout their lives and stay up to date with the newest advancements in technology. It is characterized by flexibility in subjects and schedules. It focuses on practical skills without diving too far into theories. Also, it is accessible across a variety of platforms for free or at affordable prices.

### 1.2. *Characteristics of Non-Formal Education*

Faure's [1] main characteristics about non-formal education are as follows:

- **Flexibility:** The non-formal education is flexible and adaptable, catering to the diverse needs and circumstances of learners.
- **Voluntary Participation:** Participation in non-formal education is usually voluntary. Learners willingly engage in these educational activities based on their interests, needs, and motivations.

- **Diversity of Content:** Non-formal education covers a wide range of topics, many of which go beyond what's covered in traditional education. It embraces areas for personal development, as well as practical knowledge as well as skills.
- **Accessibility:** Non-formal education seeks to reach people who might not have had easy access to traditional educational because of a variety of factors, such as geography, schedule conflicts, or unique personal situations.
- **Informality in Structure:** Non-formal education is frequently more casual than formal education, which has strict curricula and structures. It supports a variety of arrangements and formats, enabling innovative and imaginative teaching strategies.
- **Lifelong Learning:** Non-formal education is in favor of lifetime learning, which holds that opportunities for learning should not be restricted to a person's age or stage of development but should be always available to them.
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The function of non-formal education is to develop the potential of students with an emphasis on mastering functional knowledge and skills and developing professional attitudes and personalities (Elice *et al.*, 2023). Non-formal education responds to the learning needs of a group and can be carried out, in seminars, training sessions, workshops, through partnerships between facilitators and participants, in groups or communities or in other organizations other than in the education system. It does not end with the granting of certificates but usually it takes place within an institutionalized framework, outside the school system, comprising extra class or extra didactic activities like competitions, extracurricular education, and training activities (Vilceanu, 2019).

Non-formal educational activities have a positive impact university students' academic success and employability, enhancing their readiness for the job market through holistic development beyond the curriculum (Norberto *et al.*, 2023).

## 2. Research Method

Depending on the Statistical Yearbook – Education 2023 of the Central Agency for Public Mobilization and Statistics in Egypt (CAPMAS) which is considered a comprehensive statistical reference for all official statistics, the annual number of graduates from engineering and computer science faculties is almost 35 thousand graduates. It is increasing every year by 15%. A small percentage of these graduates are joining the non-formal educational system that operates in various institutions such as the AAST Regional Informatics Center (RIC).

The aim for this study is to investigate the impact of these non-formal educational activities on engineering and computer science students' academic performance as well as their chances to obtain a job after graduation.

The study will examine different aspects may be impacted by participating in these non-formal educational approaches, such as the ability to work in groups, time management skills, problem-solving skills, and creativity, as well as how engagement in non-formal activities may lead to job opportunities.

A questionnaire of two sections was used to collect the data. The first section of the questionnaire introduces the research's goal and the criteria that questionnaire participants should meet. Following this introduction, some personal information is gathered, such as the participant's age, gender, education level, university, and prior RIC activities.

The questionnaire's second section consisted of 12 statements and separated into two parts.

The first part has 6 statements that measure the impact of the RIC activities on the academic performance:

1. GPA Improvement.
2. Self-Learning Skills.
3. Problem-Solving and Creativity.
4. Time Management Skills.
5. Encouragement to join engineering field.
6. Ability to get a scholarship.

The second part of the questionnaire contains 6 statements that measure the impact of the RIC activities on the employability skills and opportunities as follows:

1. Chances for getting a job or internship.
2. Ability to work under stress.
3. Communication skills improvement.
4. Ability to work in groups.
5. Creating social networks.
6. Early participation giving an edge.

The research population consists of undergraduates and graduates who participated in non-formal educational approaches during their high school or university studies. The questionnaire was not open to everyone. The Purposive Sample Technique was applied

to identify the individuals that best suited to answer the research question. The questionnaire participants should meet the following requirements:

1. The participant must be a student or graduate of an engineering or computer science faculty.
2. The participant must have joined at least one of the RIC activities or similar activities while in high school, university, or both.

The RIC activities are the Egyptian/International Olympiad in Informatics (EOI/IOI), Egyptian/International Collegiate Programming Contest (ECPC/ICPC), RoboCup, Remotely Operated Vehicle (ROV), International Challenge on Informatics and Computational Thinking (Bebras), Formula Students and Robocon or similar activities like the Egyptian/International Math Olympiad (EMO/IMO), Catch the Flag (CTF) and Intel ISEF.

## 3. Results and Findings

As mentioned above, the number of graduates from engineering and computer science faculties in Egypt in 2023 is almost 35 thousand graduates and increasing every year by 15%. A small percentage of these graduates are joining the non-formal educational system that operates in various institutions such as the Arab Academy for Science, Technology, and Maritime Transport, Regional Informatics Center (AASMT-RIC). These non-formal educational activities are directed towards high school students and undergraduates. All the activities are focusing on the computer science and robotics fields.

In order the get accurate responses, the questionnaire was distributed to 800 individuals that participate in the AASTMT-RIC activities or similar activities while we receive 270 responses.

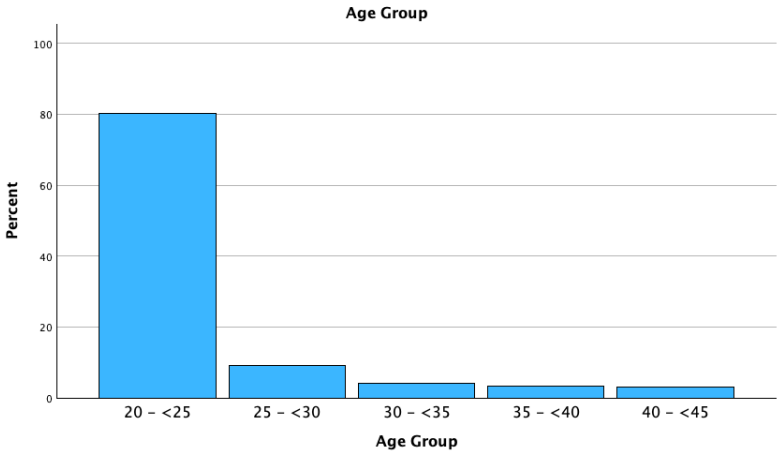
The following section shows the analysis for the demographic part of the questionnaire in addition to the academic performance and employability.

### 3.1. *Demographic Analysis*

#### 3.1.1. *Age Group*

The majority of survey respondents – more than 80% – are in the 20–25 age range. They continue to attend the institution to study. The primary concern that came from

| **Age Group** | N | % |
|---|---|---|
| 20 – <25 | 217 | 80.4% |
| 25 – <30 | 25 | 9.3% |
| 30 – <35 | 11 | 4.1% |
| 35 – <40 | 9 | 3.3% |
| 40 – <45 | 8 | 3.0% |

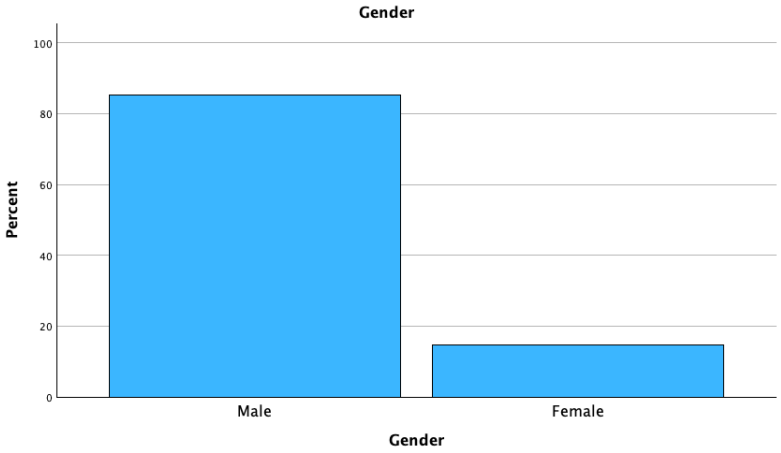



this inquiry is that we don't maintain close relationships with our graduate students, or, to put it another way, we don't communicate well with them. This could indicate how crucial it is to have alumni involved in every activity to maintain the flow of knowledge by putting former students in touch with current ones.

### 3.1.2. *Gender*

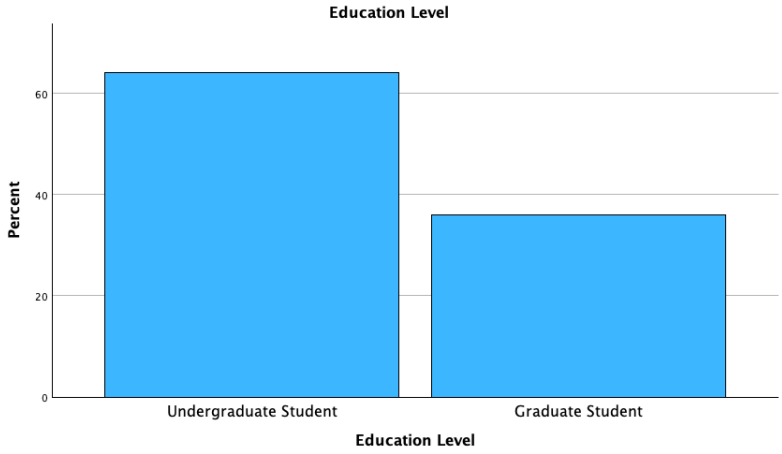
Given that most participants in the non-formal activities are males, the male to female ratio is reasonable. To prevent the discouragement that could result from not winning or achieving the top level in the competitions, we might need to make more effort to engage more girls or split the prizes between males and females.

| **Gender** | N | % |
|---|---|---|
| Male | 230 | 85.2% |
| Female | 40 | 14.8% |



### 3.1.3. *Education Level*

| **Education Level** | N | % |
|---|---|---|
| Undergraduate Student | 173 | 64.1% |
| Graduate Student | 97 | 35.9% |



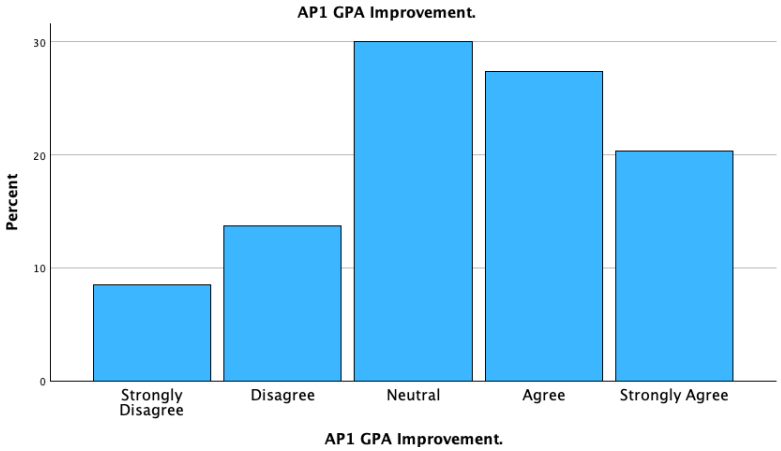

Undergraduates make up the majority of participants, according to the Age group responses. Of the participants, around 64 percent are still enrolled in university courses. This is could be considered as a limitation in the research.

## 3.2. *Academic Performance*

### 3.2.1. *Participating in RIC Activities Helped me to Improve my GPA and Grades*

GPA stands for Grade Point Average. It's a numerical way to summarize a student's academic performance over time. Grade point average (GPA), obtained credits (ECTS) and gender to be the most consistent and decisive predictors of academic performance (Kocsis & Molnár, 2024). Nearly 48% of participants stated that their GPA is positively impacted by their participation in extracurricular activities. A 30% of the participants believe that extracurricular activities have no impact directly on their GPA, while the remaining 22% believe that involvement in these activities lowers their GPA. This could be because of the extra time needed for non-formal activities, which could result in less study hours for formal education courses. This inquriy should have an impact on the fourth question which is related to the improvement of the Time-Management skills.

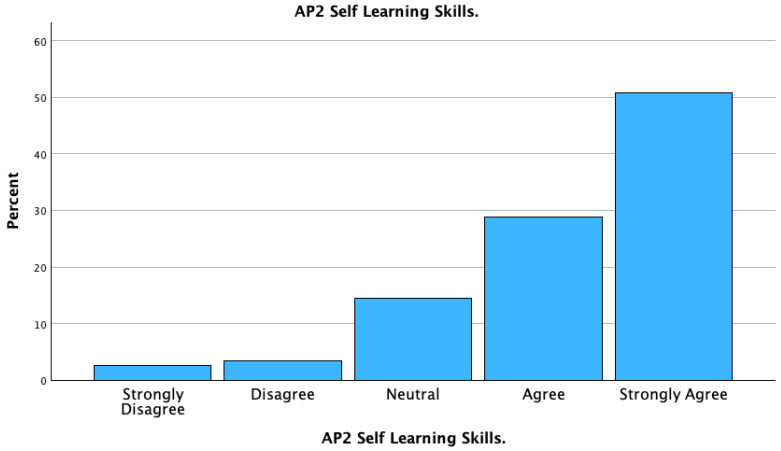
| **AP1 GPA Improvement** | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| N | 23 | 37 | 81 | 74 | 55 |
| % | 8.50% | 13.70% | 30.00% | 27.40% | 20.40% |




### 3.2.2. *I became a self-learner after I joined the RIC activities*

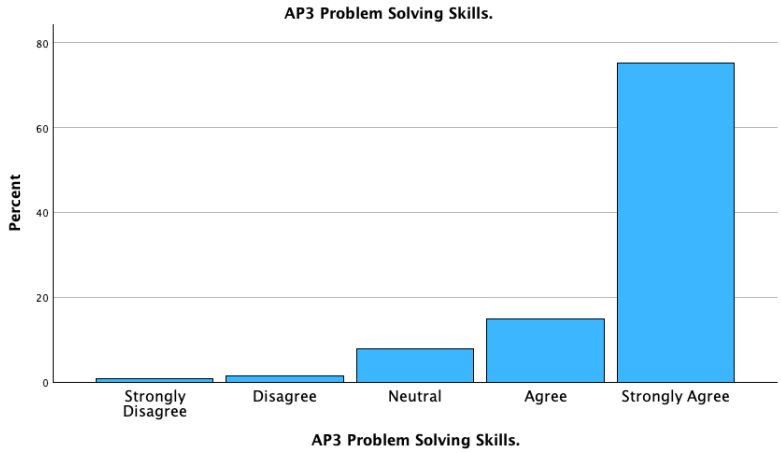
Self-learning skills empower students to become independent, adaptable, and lifelong learners. It's a valuable asset that benefits them throughout their academic journey and beyond. Self-regulated online learning skills were a significant predictor of academic success (Tijen, 2022). The questionnaire responses make it clearly evident that taking part in non-formal educational events has a significant influence on students' abilities for self-learning. Nearly 80% of participants said that after participating in extracurricular activities, they turned into self-learners. Of the respondents, about 6% believe that the activities had no influence on their ability to learn on their own, while the remaining respondents observe no change in either direction.

| **AP2 Self Learning Skills** | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| N | 7 | 9 | 39 | 78 | 137 |
| % | 2.60% | 3.30% | 14.40% | 28.90% | 50.70% |



### 3.2.3. *Participating in RIC Activities Improved my Problem-Solving Skills and Creativity*

| **AP3 Problem Solving Skills** | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| N | 2 | 4 | 21 | 40 | 203 |
| % | 0.70% | 1.50% | 7.80% | 14.80% | 75.20% |

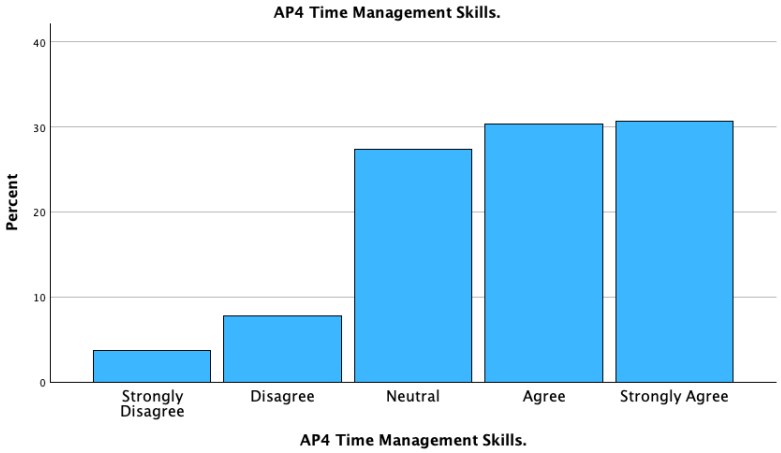



Extracurricular activities are considered essential for optimal intellectual development, complementing school activities (Miltiadis, 2022). Problem-solving skills are key for students. They boost academic success, critical thinking, confidence, and teamwork. They prepare students for a world full of challenges. The graph above makes it clearly obvious that engaging in extracurricular activities greatly enhances the ability for creativity and problem-solving. 87% of the participants agreed that participating in competitions improves their creativity and problem-solving abilities.

### 3.2.4. *Joining the RIC Activities Improved my Time Management Skills*

The goal of time management skills is to maximize every day. They are crucial since it seems like we never have enough time to accomplish what we need to or want to. You can accomplish your goals, be more productive, and experience less stress if you have good time management abilities. The effective coping strategies, such as good time management, can lead to better academic outcomes and career development for nursing students (Achamma & Nirmala, 2023). As we could see from the results, time-management skill is affected positively by engaging in non-formal activities. More than 88% of the responses indicate that the students gain the ability to divide the daytime between the formal and non-formal education.

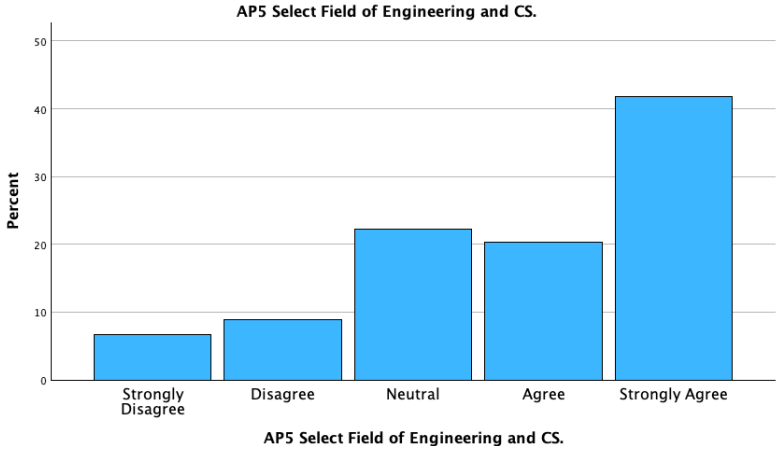
| **AP4 Time Management Skills** | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| N | 10 | 21 | 74 | 82 | 83 |
| % | 3.70% | 7.80% | 27.40% | 30.40% | 30.70% |




### 3.2.5. *Participating in the RIC Activities Helped me to Early Select my Field of Study and Join the Engineering and Computer Science Career*

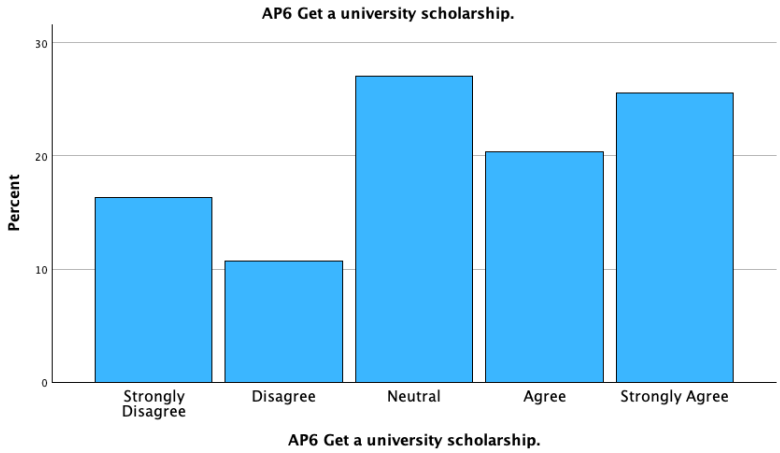
Early career thinking helps students discover their strengths and interests, setting goals and staying motivated in school. Out-of-school STEM activities positively influenced the STEM career choices of female students (İsmail, 2021). As we can see in the graph, more than 60% agreed that participating in the non-formal activities encourage more students to join the engineering or computer science fields. A research by (Viacheslav *et al.*, 2020) found that Graduates with STEM training closely connected to their future profession show a higher tendency to choose relevant study directions.

| **AP5 Select Field of Engineering and CS** | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| N | 18 | 24 | 60 | 55 | 113 |
| % | 6.70% | 8.90% | 22.20% | 20.40% | 41.90% |



### 3.2.6. *Joining the RIC activities enhances my chances for getting a university scholarship.*

| **AP6 Get a university scholarship** | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| N | 44 | 29 | 73 | 55 | 69 |
| % | 16.30% | 10.70% | 27.00% | 20.40% | 25.60% |



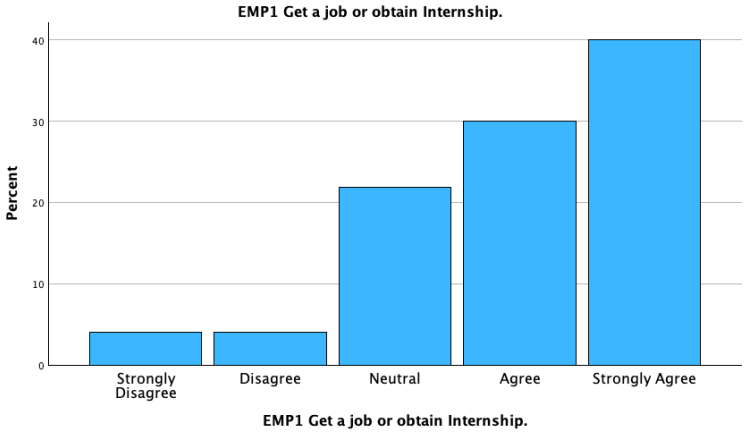

Not every high school student who participated in extracurricular activities will be awarded a scholarship to attend a university. Several other criteria also have a role, such as the degree of student participation and the universities' ability to award grants. The graph indicates that there isn't a pattern in the replies. The majority of universities award scholarships to students who participate at the highest levels, such as the IMO and IOI. Very few young people were able to participate to this extent, and even fewer were able to receive a medal. This appears to be one of the causes of the equal percentage of answers without a dominant response.

## 3.3. *Employability*

### 3.3.1. *By Taking Part in RIC Activities, my Chances of Getting a Job or Obtaining an Internship Increased*

Extracurricular activities (ECAs) mostly have a positive impact on university students' academic success and employability, with only a few showing negative effects (Vilceanu, 2019). Employers perceive extracurricular involvement as a moderate influencer of graduate employability (Bodunrin, 2017). According to the responses, 70% of the students believed their chances of obtaining a job or an internship were improved by their involvement in non-formal activities. The activities outside of school help students become more competent and ready for the workforce.

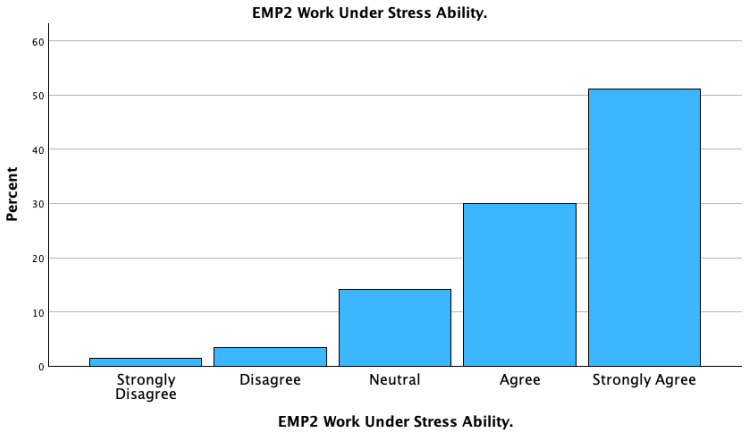
| EMP1 Get a job or obtain Internship | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| N | 11 | 11 | 59 | 81 | 108 |
| % | 4.10% | 4.10% | 21.90% | 30.00% | 40.00% |




### 3.3.2. *Participating in the RIC Activities Helped me to Improve my Ability to Work under Stress*

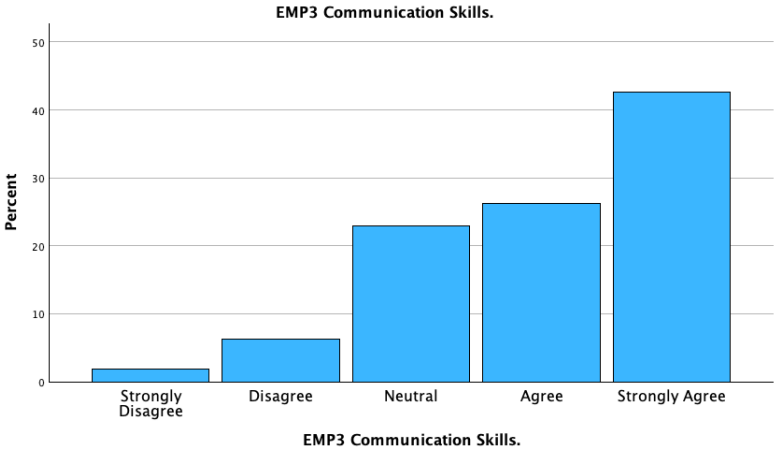
The ability to work under stress is a valuable skill that many employers highly value. University students have a high willingness to develop all soft skills, with stress management being prioritized as a significant developmental need (Esra, 2023). The results show that more than 80% of the students agreed that non-formal educational activities developed their work under stress skill. The ability to work under stress is a skill that can be developed and improved over time with practice and self-awareness.

| EMP2 Work Under Stress Ability | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| N | 4 | 9 | 38 | 81 | 138 |
| % | 1.50% | 3.30% | 14.10% | 30.00% | 51.10% |



### 3.3.3. *Joining the RIC Activities Improved my Communication Skills*

| **EMP3 Communication Skills** | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| N | 5 | 17 | 62 | 71 | 115 |
| % | 1.90% | 6.30% | 23.00% | 26.30% | 42.60% |

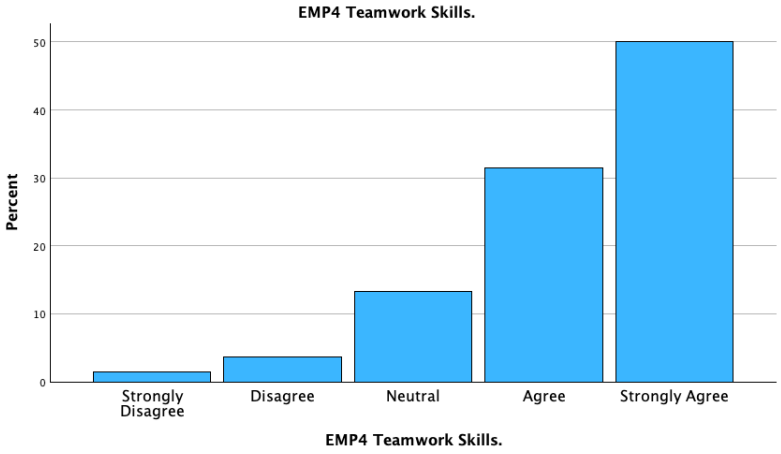



Improving communication skills can have a significant impact on both personal and professional life. It is obvious that participating in the non-formal activities positively affect the students' communication skills. Improving communication skills takes time and effort, but the benefits are invaluable in personal relationships, teamwork, leadership, and overall career success.

### 3.3.4. *Taking Part in RIC Activities Improved my Ability to Work in a Team and Respect others' Opinions*

The ability to work effectively in groups significantly impacts an individual's career advancement opportunities. Teamwork is a vital part of learning. If the major of students is software engineering, working in group is their daily working way. When they are students, mastering how to work in group is crucial to their careers (Chenyang, 2021). Majority of students agree – more than 81% of survey respondents – that participation in extracurricular activities improves group work. It also improves the acceptance of different points of view and cultural traditions. Employers in multinational companies place a high value on this ability. Working across cultural and linguistic divides has become imperative in today's world.

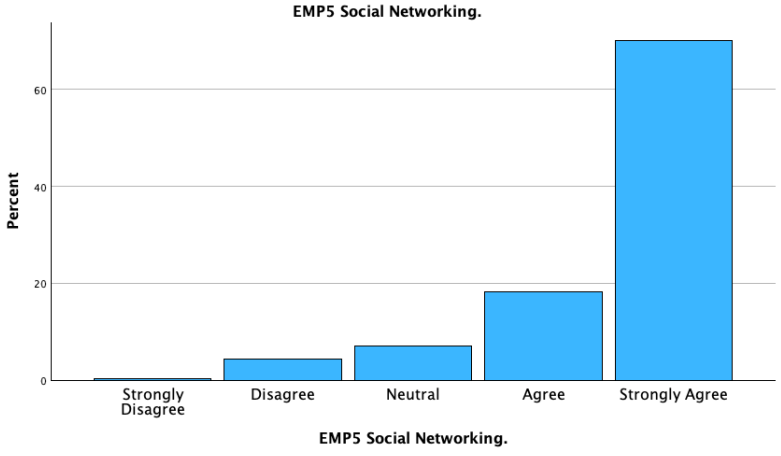
| **EMP4 Teamwork Skills** | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| N | 4 | 10 | 36 | 85 | 135 |
| % | 1.50% | 3.70% | 13.30% | 31.50% | 50.00% |




### 3.3.5. *By Participating in the RIC Activities, I Created a Social Network of People who had the Same Interest in my Studying Field*

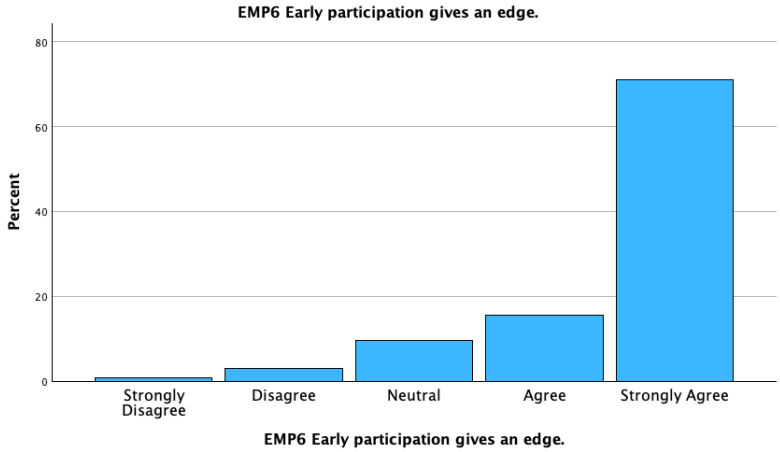
Social connectedness is crucial for employability and career success, benefiting individuals in job acquisition, career advancement, and professional learning (Ruth *et al.*, 2019). Almost 88% of the questionnaire responders confirm the positive impact of joining the RIC activities on creating social networks of people who have the same interest from the same studying field. Passion sharing among professionals can result in information sharing about current trends, employment openings, and industry expertise. This network may prove to be an invaluable asset in discovering forthcoming prospects or obtaining recommendations.

| **EMP5 Social Networking** | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| N | 1 | 12 | 19 | 49 | 189 |
| % | 0.40% | 4.40% | 7.00% | 18.10% | 70.00% |



### 3.3.6. *Early Participation in the RIC Activities Gives an Edge to the Students*

| **EMP6 Early participation gives an edge** | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| N | 2 | 8 | 26 | 42 | 192 |
| % | 0.70% | 3.00% | 9.60% | 15.60% | 71.10% |




Students participate in non-formal education programs to complement their formal studies and enhance their qualifications. Students also engage in these programs to utilize leisure time, develop social networks, and enjoy learning new things, focusing on acquiring attitudes and skills (Coombs & Ahmed, 1974). More than 85% of respondents said they thought being involved in RIC activities early on gave them an advantage over their peers.

## 4. Conclusion

In conclusion, the evidence presented underscores the significant positive impact of non-formal education on both academic performance and employability among students. Through various non-traditional learning experiences, such as workshops, internships, and skill-based programs, students have been able to enhance their cognitive abilities, practical skills, and overall competencies. This exposure not only enriches their academic journey by complementing formal education but also equips them with the necessary tools and attributes sought after by employers in the professional arena.

Furthermore, the versatility of non-formal education allows students to cultivate a broader skill set that extends beyond conventional academic subjects, fostering adaptability and innovation. By participating in diverse learning environments outside the classroom, students gain practical insights and hands-on experiences that are instrumental in preparing them for the dynamic demands of the workforce.

The outcomes are clear: students who engage in non-formal education demonstrate improved academic outcomes, while also showcasing enhanced employability through the development of critical soft skills, problem-solving abilities, and professional networks.

As education continues to evolve, incorporating non-formal educational opportunities into mainstream curricula and career development strategies should be prioritized. This integration not only enriches the educational experience but also cultivates a generation of students better equipped to thrive academically and professionally in an ever-changing global landscape. Thus, the promotion and support of non-formal education initiatives are essential for empowering students and maximizing their potential in both academic pursuits and future career endeavors.

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