Journal of Turkish Science Education, 2022, *19*(2), 438-464.
DOI no: 10.36681/tused.2022.130

Journal of Turkish Science Education
http://www.tused.org
© ISSN: 1304-6020

The Views of Academics and Specialists on STEM and Related Concepts

Devrim Akgunduz[1], Aysegul Kinik Topalsan[2], Zeynep Turk[3]

[1]*Istanbul Aydin University, Turkey, devrimakgunduz@aydin.edu.tr, ORCID ID: 0000-0002-4684-8416*
[2]*Istanbul Aydin University, Turkey, ORCID ID: 0000-0003-0947-5355*
[3]*Istanbul Aydin University, Turkey, ORCID ID: 0000-0001-6744-1255*

ABSTRACT
This study aimed to determine the perceptions of academics from different faculties and experts from non-governmental organizations, and Research & Development (R&D) centers of the concepts of STEM, innovation, entrepreneurship, industry 4.0, robotics, coding, maker, artificial intelligence, and their reflections on the daily life. In addition, within the scope of the research, opinions about the status of entrepreneurship and innovation capacity in the universities and what should be done in the short, medium, and long term regarding these concepts were also examined. A case study, one of the qualitative research models, was used in the research. The research was carried out with the participation of a total of 24 people, including academics from different faculties and experts from non-governmental organizations and R&D centers. The opinion form for the concept, entrepreneurship, and innovation was used as a data collection tool. In the first part of the form, the concepts of STEM, innovation, entrepreneurship, industry 4.0, robotics, coding, maker, and artificial intelligence concepts and their examples were investigated. In the second part of the form, an evaluation of the current situation (problems and current studies) of entrepreneurship and innovation capacity in Universities and especially education faculties were inquired. Additionally, it was asked what needs to be done in the short-, medium-, and long-term regarding concepts. The qualitative data obtained were evaluated using descriptive statistics. It has been revealed that academics from different departments have different definitions of STEM and other concepts.

ARTICLE INFORMATION
Received:
08.04.2021
Accepted:
02.11.2021

KEYWORDS: STEM education, STEM, entrepreneurship, robotics, artificial intelligence.

To cite this article: Akgunduz, D., Kinik Topalsan, A. & Turk, Z. (2022). The views of academics and specialists on STEM and related concepts. *Journal of Turkish Science Education, 19*(2), 438-464.

Introduction

Developments in technology, industry, and engineering fields worldwide increased the competition of countries with each other. The 21st century is witnessing rapid changes in lifestyle due to the emerging technology. A new era has been started, where science fiction has become the phenomenon of science and technology fusion is the main driving force (Bongomin et al., 2020). For this reason, it becomes important to ensure that any advancement in technology reaches everyone is beneficial and to train the workforce to provide this. Most people in the future will work in different professions. Therefore, it is necessary to discuss how people can remain competitive in the new economy, how they can develop the skills needed, and how educational institutions should change to address the new economic reality (Ford, 2015; Webster, 2019). Changes and improvements in the education and training system should be made urgently within the scope of these discussions to meet the future needs of education policies, which is one of the most important dynamics of the country for the sustainable improvement of economies (Harteis, 2018, Rotherham & Willingham, 2010). Arrangements to be made in education policies should be qualified to train a workforce with high scientific creativity, innovation and digital skills in the fields of science, technology and engineering.

Especially in the 21st century, where Industry 4.0 has spoken and artificial intelligence is in all areas of our lives, digital skills are very important for people to benefit from the benefits of digitalization (OECD, 2019a). The future demands employees who can solve problems in technology-rich environments and have creative and interpersonal skills in the digital environment (OECD, 2018; OECD, 2019b). It is thought that this demand for workforce, in the light of the studies conducted, will not be met with the knowledge that is processed in formal education institutions and cannot be reconciled with real-life (Akgunduz & Mesutoğlu, 2020, 2021; NRC, 2012; TÜSİAD, 2017).

It can be said that in this period of rapid transition from the industrial society to the knowledge society, we are transferred to different new educational approaches rather than traditional education approaches. One of them is STEM education (Akgunduz, 2019 (Ed.), Akgunduz et al., 2018; Bybee, 2010). STEM education helps students to produce numerous innovative solutions to 21st-century problems creatively and systematically while improving students' innovation capacities and critical thinking skills and supporting the emergence of the expected workforce (Akgunduz et al., 2018; Bybee 2018; Johnson et al., 2015; Martín-Páez et al., 2019; NRC 2012; NAE & NRC 2014). It is also capable of improving students' preparation for future professions (Chachashvili-Bolotin et al., 2016; Fan & Yu 2017; Murphy et al., 2019; Schleicher et al., 2019). Countries around the world, to manage their rapidly changing environments; use STEM education and invest in Industry 4.0, such as innovating new technologies, ensuring welfare and security, providing clean water and food resources (Council of Canadian Academies, 2015; ICF & Cedefob, 2014; National Science & Technology Council, 2013; Office of the Chief Scientist, 2013). STEM is one of the most important elements that should be included in the education system for the development, scientific leadership, and economic growth of a country (Lacey & Wright, 2009). In order to achieve this growth and development in the best way, the STEM education approach should be included in the education policies of the countries (Akgunduz et al., 2015; Akgunduz, 2016). Given the importance and urgency of this requirement, STEM education receives wide support from industry, policy makers, and educators (Myers & Berkowicz, 2015; Shanahan et al., 2016).

The 21st century requires individuals to work collaboratively on local and global problems (National Research Council, 2012). STEM education emphasizes the integration of multiple disciplines in the context of real-world issues (The National Academy of Sciences, 2014). Moore et al. (2014) define integrated STEM education as follows: It is an effort to unite some or all the four disciplines of science, technology, engineering, and mathematics into a single class, unit, or course based on the connections between subjects and the real world.

Thanks to STEM education, concepts such as technology, digitalization, artificial intelligence, and 3D printers have gained more importance to make interdisciplinary interaction effective, and the concepts of coding, robotics, and maker have come to the fore for an upcoming generation (TUSIAD, 2017). Within this scope, the importance of coding education has been recognized and coding training has begun to be given according to each level. Although coding is a new term according to robotics, it has started to gain a place for itself from preschool to undergraduate education and has quickly become a part of education. Coding is defined both as a new literacy for the 21st century. and as the ability to solve problems algorithmically and develop a sense of technological fluency (Wing, 2006). Academic communities in Europe; The Royal Society of England (Furber, 2012), Academie des Sciences in France (L'Académie des sciences, 2012), and Sociedad Científica Informática in Spain (Meseguer et al., 2015) played an active role in programming. Sixteen European countries have included coding in their training programs with different approaches and at different levels (Balanskat & Engelhardt, 2015; Bocconi et al., 2016).

STEM, coding, and robotics were used in teaching different disciplines, especially in science education, and they started to be an alternative educational tool and approach. Some studies show that robotics can be effective in STEM teaching because it helps reduce the abstraction of mathematics and science and creates opportunities for real-world engineering and technology applications (Nugent, Bradley, Grandgenett & Adamchuk, 2010). In addition, according to Chung et al. (2014), robotics-based STEM teaching is more advantageous than traditional STEM teaching in terms of embodying abstract concepts, combining multiple disciplines, providing hands-on learning by linking theory and practice, and making it fun.

The technological developments in the world and the concepts created by technology are far beyond memorizing today.. Among these, there are two other important areas besides STEM, robotics, and coding. The first of these is artificial intelligence. Artificial intelligence is a concept used to describe systems that can display abilities such as learning, creativity, and intuition at a human level. It is an important technology that supports daily social life and economic development. It contributes greatly to the sustainable growth of the Japanese economy, it has also attracted attention as the key to growth in developed countries such as Europe and the United States of America and developing countries such as China and India (Lu et al., 2017).

Industry 4.0, which emerged in Germany, refers to the fourth industrial revolution that emerged after the developments in information and communication technologies (Gilchrist, 2016; Rojko, 2017). Industry 4.0 consists of cyber-physical systems, the internet of things (IoT), information, innovation, and talent (Kamsi et al., 2019; Rojko, 2017). The industrial Revolution plans all units that are directly or indirectly related to production to work together with each other and foresees the integration of digital data software and information technologies (Chou et al., 2018; Schuh et al., 2014; Yıldız & Agdeniz, 2019). STEM develops students' creative skills for production such as critical thinking and industrial mindset and prepares them for industry 4.0 (Hafni et al., 2020). The advancement of Industry 4.0 shows how people are getting smarter through the integration of technology, continuous learning in various environments, and developing skills like technology use, knowledge proficiency, willingness to learn, problem solving, collaboration, teamwork, adaptability to change, agility etc. (Tvenge & Martinsen, 2018). The term "Industry 4.0" has been introduced not only in academic life but also in industrial society. Envisioning the Future of Education and Jobs report predicts that Industry 4.0 creates new professional fields with advances in information technologies and constantly changes the way jobs are defined (Schleicher et al., 2019). Achieving sustainable economic growth worldwide, advancing technology and innovation capacity, and encouraging productivity, creativity and entrepreneurship are among the fundamental first steps (International Labor Organization, 2019).

The Importance and Purpose of the Research

Globally, universities are facing an increasingly dynamic environment, and many have responded by becoming more entrepreneurial. European and US universities have adopted new governance structures, diversified their funding, changed their organizational structures, and adopted an entrepreneurial culture to drive more innovative behavior. In such a period, it is necessary to raise awareness about the concepts adopted by the world and to correct any conceptual misunderstandings. There are still many different explanations of STEM and STEM-related concepts in Turkey and the world. For this reason, in order to develop a common perspective of these concepts, it is necessary to reveal all the views about the concepts. Research of the database sources revealed no studies that gathered opinions of STEM or STEM-related concepts from different stakeholders. Therefore, a study with participation of different stakeholders was carried out to address the deficiency in this context.

It is very important to correctly perceive the aforementioned concepts for the correct interpretation of the current education policy to be interpreted correctly. This study aimed to determine the perceptions of academics and experts working in different fields of STEM, innovation, entrepreneurship, Industry 4.0, robotics, coding, maker, and artificial intelligence concepts and its’ reflection on their daily lives. In addition, opinions about the state of entrepreneurship and innovation capacity of the Education faculties of Universities and what should be done in the short-, medium-, and long-term regarding these issues were assessed. In this context, research questions were determined as follows.

1. What are the differences and similarities between the views of academics and experts on STEM, innovation, entrepreneurship, Industry 4.0, robotics, coding, maker, artificial intelligence-related concepts?

2. What are the opinions of academics and experts on the current state of entrepreneurship and innovation capacity at the University and specifically in Education faculties?

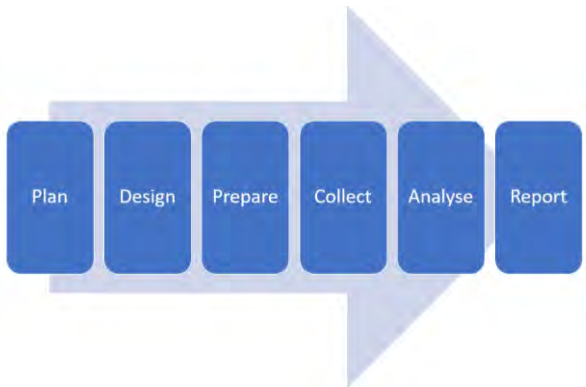
3. What should be done in the short-, medium-, and long-term to increase the entrepreneurship and innovation capacity of universities and specifically Education faculties, according to the academics and experts?

Methods

The research was carried out with a case study. A case study is a qualitative research approach in which the researcher examines one or a few situations that are limited in time with data collection tools that include multiple sources, situations and situational themes are defined (Creswell, 2007). In this research, we used the six-step process (Figure 1) approach by Yin (2013).

Figure 1

Case Study Research Approach



Note. (Yin, 2013)

Working Groups

The working group of this research consists of academics who work at different faculties of different universities and experts who work in non-governmental organizations who voluntarily attend the roundtable meeting held within the scope of an international conference held in Istanbul. All participants were brought together and grouped according to their common characteristics. The first group consists of academics of the Faculty of Engineering (EG), the second group consists of academics of the Faculty of Education-Elementary Education program (ELG), the third group consists of academics of the Faculty of Education-Science Education program (SEG) and the last group consists of experts of the NGO and R&D units. The 24 competent people in their respective fields participated in the study. The EG consists of seven individuals, four of which are women and three are men. The NGOG consists of five individuals, one male, and four females. Two participants of a six-person SEG group are females and four are men. The ELG group consists of female participants only.

Application Process

First, the working groups were given an open-ended form consisting of two parts and they were asked to fill in this form by discussing it within the group. Afterward, each group chose a group representative, and all statements in the form were explained in detail by the group spokesperson. Finally, the opinions of all participants regarding the statements made by the group representative were received and the study was concluded. With the permissions of all the participants, voice recordings of the discussions were taken, and it was ensured that nothing was overlooked during the explanations and interpretations

Data Collection Tool

The data were collected with an open-ended questionnaire. In order to prepare open-ended questions, first, the concepts of STEM, STEM Education, Industry 4.0, robotics, innovation, coding, maker, entrepreneurship, and artificial intelligence were investigated in the bloom operator, and the studies made since 2010 were examined. After that, open-ended questions were prepared by the research team and sent to two different field experts for review. The questions were revised and for the last step, the opinion of a language expert was considered. The research questions was completed by obtaining the content validity approval by a measurement and evaluation expert. "The Opinion Form for Concept, Entrepreneurship, and Innovation" was prepared by the researchers and arranged by taking the opinions of two field experts. The prepared form consists of two parts.

• In the first part of the form, the participants were asked to explain the concepts of STEM, innovation, entrepreneurship, Industry 4.0, robotics, coding, maker, and artificial intelligence, and they were asked to give examples for these concepts.

Sample question: Make a group definition using your existing knowledge about the terms STEM, innovation, entrepreneurship, industry 4.0, robotics, coding, maker, artificial intelligence. Add a sentence to each term that begins with an example.

• In the second part of the form, the participants were asked to evaluate the current situation of entrepreneurship and innovation capacity in universities and especially education faculties (in the perspective of their problems and current studies) and What should be done in the short-, medium-, and long-term to increase the entrepreneurship and innovation capacity of universities and specifically Education faculties, according to the academics and experts?

Sample question: Evaluate the status (problems and current studies) of entrepreneurship and innovation capacity in universities and especially in education faculties and indicate below.

Data Analysis

All opinions expressed by the working groups were collected in writing on the form and recorded with a tape recorder. The opinions of each group written on the form were examined and the sound recordings were deciphered by the researchers. The data were analyzed using the descriptive analysis method. The descriptive analysis approach allows the data to be organized according to the themes revealed by the research questions and to be presented by considering the questions or dimensions used in the interview (Yıldırım & Şimşek, 2013). The descriptive analysis consists of four stages (Altunışık et al., 2010). These stages are: (i) establishing a framework for descriptive analysis, (ii) processing the data according to the thematic framework, (iii) describing the findings, and (iv) interpreting the findings.

Collected data are reported in detail and the researchers explain how they arrived at the results. In qualitative research, this situation is one of the most important criteria of validity (Yıldırım & Şimşek, 2013). To ensure the reliability of the qualitative research, the researchers explained the position and characteristics of the participants in the research process in detail. According to Glesne and Peshkin (1992), sharing the data obtained in qualitative research with people who are experts in qualitative research and getting feedback increases the reliability of the research (Yıldırım, 2010). Therefore, before the research, three field experts except the researchers were consulted while preparing the data collection questions and during the analysis process. To ensure the internal reliability (consistency) of the research, direct quotations are included in the findings. To increase the reliability of the research data, the data were read before the analysis, misunderstandings and extraneous data were removed and excluded from the data analysis process. The researchers evaluated the agreement points for their analysis and determined that there was 94% agreement in the analysis of the interview data with the formula (Bakeman & Gottman, 1997, p. 60). Miles & Huberman (1994, p. 64) state that studies in which the agreement rate is greater than 90% are reliable. The value obtained shows that the research meets the reliability conditions.

Findings

Findings for Concept Knowledge

The first question of the research; "What are the differences and common points between the opinions of academics and experts on the terms of STEM, innovation, entrepreneurship, industry 4.0, robotics, coding, maker, and artificial intelligence**?"**

The Concept of STEM

To determine how the concept of STEM is perceived in different groups, all groups participating in the research process were asked to define the concept of STEM.

Table 1

Definitions of the STEM Concept According to the Groups

Definitions of the STEM concept	(EG)	(ELG)	(SEG)	(NGOG)
Integration of STEM fields	✓			✓
Problem-solving	✓	✓	✓	✓
Improving skills of 21st Century	✓			
Transdisciplinary approach		✓		✓
Interdisciplinary approach	✓		✓	
Science process skills		✓	✓	
Gaining experience and standards	✓			
Project development		✓		
Product design		✓	✓	
Production	✓	✓	✓	✓
Process			✓	✓
Interdisciplinary cooperation	✓			
Engineering design cycle			✓	

Similar Opinions: As shown in Table 1, the concept of STEM evokes the concepts of problem-solving skills and production in all groups. According to all groups involved in the research process, the concept of STEM is generally considered a suitable concept that provides an opportunity for creative solutions to complex problems and production by making discoveries. According to EG and SEG, STEM; interdisciplinary science, technology, engineering, and mathematics integrates and develops by encompassing other fields.

"STEM is an approach of bringing the fields of Science, Mathematics, Engineering, and Technology together in the context of a problem, aimed at gaining 21st-century skills, encouraging the choice of profession, and gaining experience in these fields" (EG)

"STEM is a design and a process of production in which scientific method and engineering design steps are used with an interdisciplinary perspective that can be a solution to a problem." (SEG)

TEG, on the other hand, has considered the concept of STEM as an effective strategy to meaningfully combine and use knowledge and skills belonging to different disciplines in a context of a real-life problem. TEG and SEG have emphasized "scientific process skills" and "product design" in their definition of the concept of STEM. These groups consider the concept of STEM to be an approach that allows the development of scientific process skills and produces a product, rather than teaching different disciplines by separating them from one another.

"STEM is an approach that is tried to produce a product as a result with design-oriented scientific research methods that evaluate real-life problems with supra-disciplinary approaches." (TEG)

"STEM is a design and process of production in which scientific method and engineering design steps are used with an interdisciplinary perspective that can be a solution to a problem." (SEG)

Different Opinions: There were differences in opinions between some of the study groups regarding the concept of STEM. For example, SEG mentioned the importance of the engineering design cycle concerning the STEM concept, EG mentioned that cross-field collaboration was necessary for STEM, and TEG stated that projects have evolved and shaped thanks to the STEM concept. The definition of STEM concept including the development of 21st century's skills was only made by the EG group.

Definitions related to the concept of STEM, given by the groups involved in the research process are presented below.

"STEM is an approach that brings the fields of Science, Mathematics, Engineering, and Technology together in the context of a problem, aimed at gaining 21st-century skills while encouraging the choice of a profession, and gaining experience in these fields" (EG)

"STEM is a design and process of production in which scientific method and engineering design steps are used with an interdisciplinary perspective that can be a solution to a problem." (SEG)

"STEM is an approach that aims to produce a product as a result with design-oriented scientific research methods that evaluate real-life problems with supra-disciplinary approaches." (TEG)

"STEM is a problem-solving process that ensures integration of different disciplines with interdisciplinary understanding. We had a discussion among ourselves about whether this was supra-disciplinary or inter-disciplinary." (NGOG)

Table 2

Current Examples of the Concept of STEM

Examples	(EG)	(ELG)	(SEG)	(NGOG)
A project that reduces water consumption				✓
Flying cars		✓		
Catapult made within the scope of the lesson	✓			
A robot made within the scope of the lesson	✓			
Prosthetic leg design			✓	
Helmet production for workers			✓	
Innovative bridge designs			✓	

Regarding the concept of STEM, each group gave different examples. Examples related to the concept by associating STEM concept with course contents were given, also catapults and robots made within the scope of the course were cited as examples by EG. Examples given by TEG were a little more innovative and they chose flying cars as an example. The examples provided by SEG appear to be more innovative tools for problem-solving. In this context, prosthetic legs, helmets, and innovative bridge designs are shown as examples. NGOG has taken a more activist approach by giving an example of using STEM to prepare a project for a reduction of water consumption.

The Concept of Innovation

To determine how the concept of innovation is perceived in different groups, all groups were asked to define the concept of innovation.

Table 3

Definitions of the Innovation Concept According to the Groups

Definitions of the concept of innovation	(EG)	(ELG)	(SEG)	(NGOG)
Studies to make life easier and better	✓			
Studies for problems that arise within the necessity	✓	✓	✓	✓
Innovative solutions	✓	✓		✓
Efforts to implement innovative ideas	✓	✓		
New solutions to existing problems		✓		
Innovative perspectives		✓		✓
Innovative product		✓		
Developing products with innovative technologies			✓	
Thing requested			✓	
Creative perspectives				✓
Original solutions				✓

Similar Opinions: It has been determined that the common expression emphasized by all the groups is "How to produce solutions for needs ". All groups have stated that the starting points of their innovative ideas are usually a problem, or a need faced by an individual. In addition to this statement, in addition to this statement, it has been observed that another common category except for the SEG is innovative solutions". According to all groups except for SEG, a concept of innovation helps to find innovative solutions or identify unaware issues.

"Innovation is production original solutions to existing problems with a different, innovative and creative point of view." (NGOG)

In a definition of the innovation concept made by EG and TEG, the expression "efforts to implement innovative ideas" is included. This is an important statement because according to some groups have stated that innovative solutions may be sufficient for innovation, however according to EG and TEG if these proposals of ideas and solutions are not implemented, innovation cannot be achieved.

"It is the work carried out for the realization of ideas to improve existing solutions, innovative, emerging from a problem or need and serving humanity to make life easier and better." (EG)

"They (innovations) are products, ideas, perspectives and similar things that offer new solutions to real-life problems or needs by using existing resources, differently and innovatively." (TEG)

Different Opinions: Some sub-categories that have been significant among the definitions of innovation and remain specific to only one group have been identified. For example, while EG mentioned the importance of works done to facilitate and make life better, in innovation definitions, TEG associated the search for new solutions to existing resources and all emerging products with the innovation concept. In addition, SEG mentioned that the process of developing existing products with innovative technologies, is also related to innovation and that it must be demanded for innovation.

NGOG, on the other hand, highlighted the importance of a creative perspective for innovation and the necessity of the obtained products to be original as well.

Definitions related to the concept of innovation, made by the groups involved in the research process are presented below.

"It is the work carried out for the realization of ideas to improve existing solutions, innovative, emerging from a problem or need and serving humanity to make life easier and better." (EG)

"They are products, ideas, perspectives and similar things that are created to produce new solutions to real-life problems or needs by using of existing resources, different and innovative way." (TEG)

"It is the development of products with innovative technologies in the line with the needs and demands." (SEG)

"Innovation is to produce original solutions to existing problem situations with a different, innovative and creative point of view." (NGOG)

Table 4

Current Examples of Innovation Concept

Examples	(EG)	(ELG)	(SEG)	(NGOG)
WhatsApp	✓			
Spotify		✓		
Flying cars				✓
phone models renewal			✓	
Needs based car model development			✓	

Concerning the concept of innovation, each group gave an example. EG gave an example of WhatsApp which is an application offering fast, easy, and secure messaging and calling experience, that is now available for free on phones worldwide. ELG exemplified Spotify which is the one of the most popular music listening tool. It can be noticed that both groups specified software tools as examples of innovation. As an example of innovation, SEG has demonstrated the upgrading of phone models and Needs based car model development. NGOG, on the other hand, gave an example of flying cars as a product of innovation.

The Concept of Entrepreneurship

In order to determine how the concept of entrepreneurship is perceived in different groups, all groups participating in the research process were asked to define it.

Table 5

Definitions of the Entrepreneurship Concept According to the Groups

Definitions of the entrepreneurship concept	(EG)	(ELG)	(SEG)	(NGOG)
Applications about making life easier and better	✓			
Studies about problems that arise within needs	✓	✓	✓	✓
Innovative solutions	✓	✓		✓
Efforts to implement innovative ideas	✓	✓		
New solutions to existing resources		✓		
Innovative perspective		✓		✓
Innovative product		✓		
Developing products with innovative technologies			✓	
Requested thing			✓	
Creative perspective				✓
Original solutions				✓

Similar Opinions: As it is seen in Table 5 all groups agree on a definition of entrepreneurship as work done for the solution of problems that arise within the scope of necessities. All groups except SEG have associated the concept of entrepreneurship with innovative solutions in their definitions. In addition, it is seen that EG and ELG have considered entrepreneurship as an effort to bring innovative ideas to life.

"It (entrepreneurship) is putting a system or product designed by people with innovative ideas into mass production, ensuring its sustainability by marketing it." (EG)

"Entrepreneurship is to create a product or a sustainable service that will be beneficial by using the available resources *based on a need in any field." (ELG)*

ELG and NGOG have associated the concept of entrepreneurship with an innovative perspective, unlike other groups.

"Entrepreneurship is creating a product and a sustainable service that will be beneficial by using the resources that are available based on a need in any field." (ELG)

"We defined entrepreneurship as taking risks and taking initiative with doing the right job at the right time." (NGOG)

***Different Opinions*:** Among the groups, only one group gave a different definition of entrepreneurship. For example, EG defined the concept of entrepreneurship as an attempt to make life easier. ELG, has mentioned the necessity of creating an innovative product for entrepreneurship to be possible. SEG mentioned that firstly there should be a demand for entrepreneurship and that the development of emerging products with innovative technologies can be a kind of entrepreneurship. In addition, NGOG mentioned the importance of a creative perspective for entrepreneurship and the necessity of evaluation of all original works that may arise as an entrepreneurial product.

Definitions related to the concept of innovation, made by the groups involved in the research process are presented below.

"It is to put the system or product designed by people with innovative ideas into mass production and ensuring its sustainability by marketing them." (EG)

"Entrepreneurship is to create a product and a sustainable service that will be beneficial by using the resources that are available based on the need in any field." (ELG)

"Steps were taken to deliver the products that arise in line with the needs and demands to the crowds." (SEG)

"We defined entrepreneurship as taking risks and taking initiative with doing the right job at the right time." (NGOG)

Table 6

Current Examples of the Concept of Entrepreneurship

Examples	(EG)	(ELG)	(SEG)	(NGOG)
Simit Sarayı company (Baking)	✓			
Getir company application (Delivery)		✓	✓	
Uber company application (Transportation)		✓		
Yemek Sepeti company application (Delivery)				✓
Çiçek Sepeti company application (Delivery)				✓
Sahibinden.com company application (E-Commerce)				✓
The process of making Chobani company yogurts (E-Commerce)			✓	
Armut.com company application (Home Repairs Service)			✓	

It is seen in Table 6 that the current examples given about entrepreneurship are mostly software projects developed in areas such as e-commerce and other web-based services. Among these applications, ELG highlighted Getir and Uber, SEG highlighted Getir and Armut.com, and NGOG highlighted Yemek sepeti, Çiçek Sepeti, and Sahibinden.com. On the other hand, EG exemplified Simit Sarayı concerning the concept of entrepreneurship, while SEG mentioned the production process of Chobani Yogurts as an additional example.

The Concept of Industry 4.0

In order to determine how the concept of Industry 4.0 is perceived in different groups, all groups participating in the research process were asked to define it.

Table 7

Definitions for the Industry 4.0 Concept for the Groups

Definitions of Industry 4.0 concept	(EG)	(ELG)	(SEG)	(NGOG)
Developing smart systems	✓			
Communication of production systems with the internet of things	✓			
Applications that reduce error, time, and inefficiency		✓		
Systematic interaction of design and application tools for production		✓		
The adoption of development plans of Germany by Turkey		✓		
Reflection of STEM and innovative approaches to industry applications			✓	
Flowchart				✓
The planning of the product, production, and marketing. The following the process after the product reaches the buyer.				✓

Regarding the concept of Industry 4.0, was no opinion can be considered as common within the working groups. All the groups research defined the concept of Industry 4.0 in different ways. The industrial 4.0 revolution, also known as the "Internet of Things", "The Internet of Everything" or "Industrial Internet", is, explained as the technological change of today's production with a vision of a smart factory. Therefore, this technological change has been interpreted in different ways as in this research. For example, EG defined the concept of Industry 4.0 as the development of smart systems. In addition, this group emphasized that production systems are in contact with each other, exchanging information through the Internet of Things. ELG mentioned the popularity of the concept of Industry 4.0 in Turkey, especially since Turkey adopted Germanys' industry development plan. In addition, they defined as the ability of production-oriented design and application in a way that reduces error, time, ensures maximum efficiency of production technologies. SEG defined Industry 4.0 as a reflection of STEM and innovative approaches to industrial applications. NGOG was the group that makes the most unique definition regarding the Industry 4.0 concept. They defined it as a kind of flowchart. Flow diagrams, as they are known, provide easy understanding, follow-up, and control of the algorithm. For this reason, Industry 4.0 has been compared to a flowchart due to its scope, and it is defined as a "flow" that includes the planning, production, marketing of the product, and the follow-up of the process after the product reaches the customers.

Definitions related to the concept of Industry 4.0, made by the groups involved in the research process are presented below.

"Industry 4.0 is a communication of the production system via the Internet of Things though the exchange of information with one another and in this way, it develops smart systems." (EG)

"Especially since Turkey adopted the development plan by Germany, we mentioned that it is called Industry 4.0 and discussed that there are other models in the world. They are systematically interactive

applications of design and application tools for production in a way that reduces error, time, ensures maximum efficiency of production technologies." (ELG)

"Reflection of STEM and innovative approaches on industrial applications." (SEG)

"The planning, production, and marketing of the product is a flow that involves following the process after reaching the customer. So, we defined it as a flowchart." (NGOG)

Table 8

Current Examples of the Concept of Industry 4.0

Examples	(EG)	(ELG)	(SEG)	(NGOG)
Robot technology	✓			
Autonomous systems	✓			
Amazon delivery system		✓		
Production of accumulator				✓
Car technologies			✓	
Computer components			✓	
Medical devices			✓	

When the given examples about Industry 4.0 in Table 8, were examined, it can be observed that the engineering group (EG) wanted to describe a process rather than give a single example. In this process, they have overlapped robot technologies and autonomous systems with Industry 4.0. Whereas ELG gave Amazon's delivery system as an example of Industry 4.0, NGOG stated production of the accumulator as an example. SEG, on the other hand, went on to further diversify the content and scope of the examples they gave and expanded onto car technologies, computer apparatus, and the developed medical devices.

The Concept of Robotics

In order to determine how the concept of robotics is perceived in different groups, all groups participating in the research process were asked to define the concept of robotics.

Table 9

Definitions of the Robotics Concept for the Groups

Definitions of the robotics concept	(EG)	(ELG)	(SEG)	(NGOG)
An area where devices that can perceive their surroundings are developed	✓			
Technology developed by bringing together fields such as Mechanical Engineering, Electronic Engineering, and Computer or Software Engineering	✓			
The mechanism includes software, design, mechanics, and engineering concepts		✓		
Vehicles capable of demonstrating human skills				✓
Technology inspired by living things			✓	
Technology developed with appropriate software and coding			✓	
Technologies that can be used for the benefit of humanity		✓		

It was observed that the concept of robotics is interpreted in different ways within the working groups. EG associated the concept of robotics with different fields of engineering and mentioned how these fields, by working together, have developed devices that can perceive their environment. These developed devices are also defined as robots. ELG defined the concept of robotics as a mechanism and mentioned that it includes many different areas. SEG, on the other hand, have mentioned different features within their definition of robotics. First, this group mentioned that the concept of robotics is a technology inspired by living things. They have also added the technological side developed with appropriate software code and the need for a technological tool that can be used for the benefit of humanity, into their definition of robotics. NGOG has described all vehicles demonstrating human inspired features as robotics.

Definitions related to the concept of robotics, made by the groups involved in the research process are presented below.

"It is an area where experts from fields such as Mechanical Engineering, Electronics Engineering, and Computer or Software Engineering come together to develop devices that can perceive their environment, called robots." (EG)

"Mechanism including the concepts of software, design, mechanics, and engineering" (ELG)

"They are technologies that are designed by being inspired by living beings, developed with appropriate software and code, and they can be used for the benefit of humanity." (SEG)

"They are tools that demonstrate human features.*" (NGOG)*

Table 10

Current Examples of the Concept of Robotics

Examples	(EG)	(ELG)	(SEG)	(NGOG)
Atlas Robots	✓			
Robot Vacuum Cleaner	✓			
Drones		✓		
Kitchen robot				✓
Robotic surgery			✓	
Robot arm designs			✓	

When the current examples given about the concept of robotics were examined, it observed that the concept of a robot is mentioned in the examples of all other groups except for ELG. This situation indicates that the concept of robotics and the concept of robots are overlapping. While the engineering group gave examples of atlas robots, which are humanoid, and robot vacuum cleaners, ELG specified drones as examples of the concept of robotics. SEG has given robotic surgery and robot arm designs, while NGOG has given the kitchen robot as an example.

The Concept of Coding

In order to determine how the concept of coding is perceived in different groups, all groups participating in the research process were asked to define the concept of coding.

Table 11

Definitions of the Concept of Coding for the Groups

Definitions of the coding concept	(EG)	(ELG)	(SEG)	(NGOG)
A concept that is intertwined with programming	✓			
The software we use on the computer through common intermediating languages	✓	✓		
Generating a solution to a need or problem using algorithms and mathematical functions		✓		✓

Establishing appropriate algorithms			✓	
Product design				✓
Integration of created algorithms into the fields such as robotics.			✓	

Similar Opinions: After examining the opinions of the groups it was observed that both EG and ELG groups compared the concept of coding to the software languages used by the computer.

“It is an intertwined concept with programming. It means programming. Common intermediating languages have been developed because it is difficult or impossible to speak the computer language. Through these languages, the software we use on the computer is developed.” (EG)

"To code is to solve a need or problem by using software tools, binary 0-1s, algorithms and mathematical functions." (ELG)

In addition, it was noted that ELG and NGOG refer to algorithms as the essence of the coding concept and define coding as producing solutions to a need or problem by using algorithms and mathematical functions.

"Coding is a production of *solve a need or a problem by using software tools, binary 0-1s, algorithms and mathematical functions." (ELG)*

“It is a product design with algorithmic processes in a certain field of need and knowledge.” (NGOG)

Different Opinions: As shown in Table 11, it was understood that EG perceives coding as a concept intertwined with programming. SEG has defined the concept of coding as a creation of an algorithm, with a different perspective than other groups. By further explaining these definitions, they specified that the created algorithms are integrated into the areas such as coding. NGOG has mentioned the products that emerged within the scope of coding and stated that coding is a kind of a product design.

Definitions related to the concept of coding, made by the groups involved in the research process are presented below.

“It is a concept intertwined with programming. It means programming. Common intermediate language has been developed because it is difficult or impossible to speak computer language. Through these languages, the software we use on the computer is developed.” (EG)

"Coding is to solve a need or a problem by using software tools, software 0-1s, algorithms and mathematical functions." (ELG)

"Creation of appropriate algorithms; integration of the generated algorithm into areas such as robotics." (SEG)

“It is a product design with algorithmic processes in a certain field of need and knowledge.” (NGOG)

Table 12

Current Examples of the Concept of Coding

Examples	(EG)	(ELG)	(SEG)	(NGOG)
Microsoft Office	✓			
Car sensor		✓		
Musical water shows				✓
5G technology				✓
Polar coding				✓
Smart House			✓	
Games			✓	
Educational toys			✓	
Instructional technologies			✓	

When we look at Table 12 a variety of examples of the concept of coding is given. There are differences between the coding examples among the groups. EG exemplified Microsoft Office programs, which are a kind of software package. ELG, on the other hand, showed the car sensor that alerts the driver with a sound when there is a short distance between the vehicle and the object approached. The variety of current examples given by SEG with the concept of coding is bigger than the other groups. In this context, SEG has showcased smart home technologies, educational toys, and instructional technologies as an example of coding. NGOG gave examples of shows of musical water, 5G technology, and polar coding in shopping malls and squares.

The Concept of Maker

In order to determine how the concept of the maker is perceived in different groups, all groups participating in the research process were asked to define the concept of the maker.

Table 13

Definitions of the Concept of Maker According to the Groups

Definitions of the maker concept	(EG)	(ELG)	(SEG)	(NGOG)
Needs based production using various materials	✓			
Relinking existing resources		✓		
People used to solve a problem		✓		
Making use of technological tools				✓
Technological product design				✓
Trial and error and the design process			✓	

The concept of the maker has been defined differently in all groups and different features of the concept are highlighted. Among the groups, only ELG personified the concept of maker and defined them as people who are used to finding a solution to a problem.

"People who are used to finding a solution to a problem by re-associating the existing resources" (ELG)

As the word means, the maker is every individual who carries out the iteration and problem-solving process based on "Do It Yourself, DIY". Maker means "maker, producer, constructer". ELG also mentioned that people who are makers in their definition re-associate existing resources.

Different from this definition, EG stated the concept of the maker as product design for needs.

"To produce products for needs using various materials." (EG).

While SEG defines the concept of the maker, they stated that the trial, error, and design processes, which are very popular in our country, mean maker.

"Trial-Error and Design Process." (SEG)

NGOG, on the other hand, identified the concept of the maker with technology and called designing technological products using technological tools as a maker.

"Designing your own product using technological tools." (NGOG)

Table 14

Current Examples of the Concept of Maker

Examples	(EG)	(ELG)	(SEG)	(NGOG)
Make a robot	✓			✓
Developing a need-oriented mechanism that warns when someone comes home	✓			
Sending notification to a mobile phone	✓			
Fire-extinguishing drones		✓		
Cat houses with sensors that protect from rain and heat		✓		
Car productions				✓
Try and do workshops			✓	

When the examples given within the scope of the maker concept were examined, it was observed that only the example of "making a robot" given by EG and NGOG was a common opinion. Other examples contain differences within all groups. EG referred to the mechanisms that send a warning when someone comes home as well as the notifications to mobile phones as an example of a maker. ELG, on the other hand, has stated fire-extinguishing drones, and houses that protect cats from heat and rain with the help of their sensors as examples under the title of the maker. SEG, on the other hand, showed only try it-do it workshops, which are the Turkish equivalent of the concept of the maker, as an example. The NGOG has also given car production as an example making robots, additionally. (NGOG)

The Concept of Artificial Intelligence

In order to determine how the concept of artificial intelligence is perceived in different groups, all groups participating in the research process were asked to define the concept of artificial intelligence.

Table 15

Definitions of the Artificial Intelligence Concept for the Groups

Definitions of the artificial intelligence concept	(EG)	(ELG)	(SEG)	(NGOG)
Mathematical models that mimic the human brain and learning	✓			
Artificial neural networks	✓			
Data defined to the machine by human		✓		
Software that makes inferences from algorithms		✓		
Hardware tool with human behavior				✓
Software and hardware tools				✓
High-end software that mimics the human mind and behavior			✓	✓
Humanoid software			✓	

Similar Opinions: Within the scope of artificial intelligence, only SEG and NGOG have agreed on a common view. They defined artificial intelligence as all software that imitated the human mind and behaviors.

"It is high-level, humanoid software that imitates the human mind." (SEG)

"We defined it as software and hardware tools that have human behaviors and have the ability to copy human behaviors." (NGOG)

Different Opinions: When the subcategories created within the scope of the artificial intelligence concept were examined, it can be observed that artificial intelligence was associated with software and hardware that imitates the human mind. However, when these definitions were examined among the groups, differences were found in the way of using those expressions. While defining artificial intelligence, EG emphasized mathematical models that imitate humans instead of hardware imitating human beings and added artificial neural networks to its definition. ELG, on the other hand, defined artificial intelligence as software that makes inferences from the algorithm of data defined to the machine by human. Furthermore, NGOG differently defined hardware tools and software tools that have humanoid behaviors as artificial intelligence. Also, SEG differently introduced the concept of humanoid software and defined artificial intelligence as humanoid software in its definitions.

Definitions related to the concept of artificial intelligence, made by groups involved in the research process are presented below.

"They are mathematical models that imitate the human brain and learning because of the artificial neural networks." (EG)

"Software that makes inferences from the algorithm of the data defined by the human-machine" (ELG)

"We defined it as software and hardware tools that have human behaviors; have the ability to copy human behaviors." (NGOG)

"It is a high-level, humanoid software that imitates the human mind." (SEG)

Table 16

Current Examples of The Concept of Artificial Intelligence

Examples	(EG)	(ELG)	(SEG)	(NGOG)
Alpha Go game	✓			
IBM's Watson		✓		
Auto draw		✓		
Siri			✓	✓
Digital operators			✓	

Alpha Go game developed by Google Deep Mind was presented by EG as an example of artificial intelligence. Moreover, ELG has given Watson, which is IBM's artificial intelligence program and designed as an answer to the questions about natural language. Auto draw is also among the examples that they have given. While SEG and NGOG exemplified Siri – a smart telephone assistant, SEG mentioned digital operators as an example.

Views on the Current State of Entrepreneurship and Innovation Capacity at the University and Especially in Education Faculties

The second question of the study is "What are the opinions of academics and experts about the current state of entrepreneurship and innovation capacity at the university and especially in education faculties?" in the form.

As a result of a detailed examination of the data collected in this section, the opinions about the current state of entrepreneurship and innovation capacity in universities and especially in education faculties are gathered and interpreted under the categories of "Positive" and "Suitable for Improvement".

Positive Views

When the opinions about the current state of entrepreneurship and innovation capacity in universities, and especially in education faculties were examined, not many positive opinions were found. Only the STKG group mentioned that the projects and studies created within the scope of the community services applications at universities can be interpreted under the heading of entrepreneurship. They also stated that student clubs at universities also produce entrepreneurial projects. However, they added that these studies were insufficient.

"In other words, some activities are carried out for entrepreneurship within the scope of community service activities. Student clubs can also be active in this area. It can be evaluated in this sense, but it is not sufficient. " (STKG)

Suitable Opinions for Improvement

When the groups' views on the current situation of entrepreneurship and innovation capacity in universities and especially education faculties were examined, MG mentioned the inadequacy of fields that work for entrepreneurship and innovation except for techno parks. They also mentioned that the courses given in this field were insufficient due to insufficient studies about entrepreneurship and innovation in the education faculties of universities.

"There are not many studies that can be considered entrepreneurship and innovation in universities except for techno parks. We think that there is no practice in education faculties. Only in this area, we thought the following could be useful: Istanbul Aydın University STEM Laboratory, Istanbul Aydın University Robotics Laboratory, Robotics laboratory in the Faculty of Education in Istanbul University...

How do we build innovation? How to get a patent? We do not learn about it. We cannot say anything about intellectual and industrial property rights because we do not know much about them either. We learn while obtaining a patent. We said that there are no lessons about it in the curriculum"(MG)

FBG, especially drew attention to the inadequacy of academic units that can work in this field. They pointed out that there is no academic infrastructure in the faculties that be used to work on the concepts of innovation and entrepreneurship. FBG have also stated their opinion on a very important issue of financial resources, needed in the projects production that can arise in the field of innovation and entrepreneurship. However, they added that a product could not be produced due to the inadequacy of these.

"We talked about the inadequacy of academic units in education faculties. In particular we *discussed the competencies of the academic staff and their knowledge and skills related to entrepreneurship and innovation. We decided that they were not able to sufficiently support the students in this regard because they were not equipped."(FBG)*

TEG have made a more detailed explanation about the current state of entrepreneurship and innovation capacities in faculties. According to this group, the primary problem is that these courses are taught theoretically rather than pragmatically. That is why it is impossible to develop innovative and entrepreneurial skills in those environments. Teacher candidates' entrepreneurial thinking skills are lacking because they cannot try themselves out by developing projects. In addition, TEG also mentioned the limitations of the areas where students can practice in the fields of entrepreneurship and innovation. They stated that students who could not find the opportunity to practice could not gain awareness in such areas. They also stated that the desired development in this field would not be achieved due to the current situation of academics and their point of view towards other academics.

"The courses in faculties of education are mostly theoretical. The scarcity or limitation of the fields where students can practice, and the lack of field experience of the academic staff are a problem." (TEG)

Views on What to Do in Universities and Education Faculties in the Short, Medium and Long-Term

The third question of the research was: "What are the opinions about what needs to be done in the short, medium- and long-term to increase the entrepreneurship and innovation capacity in universities and especially in education faculties? " All comments by the working group are given below:

Opinions about What Needs to Be Done in the Short Term

Academics also need to develop their thinking styles on these issues and keep themselves up to date. Specifically, pedagogical language should be developed to communicate more effectively, and more realistic connections should be established with students. All educators who will guide the student should be trained themselves in this context. Courses on innovation and entrepreneurship can be opened in universities, especially in faculties where teachers are trained. In the content of these courses, gains should be made on how to establish effective learning autonomy. It should be noted that the lessons should be workshop-based. Classroom and laboratory support should be provided to education faculties and more workshops should be included in the lessons in this area. Interactions with stakeholders in the field should be established, bridges should be established between the academy and the sector. Collaborations should be developed with the education of individuals who are more aware, who have developed learning autonomy, and who have an innovative and entrepreneurial spirit. In order to increase the effectiveness of these collaborations, the visibility, quantity, and quality of existing good examples should be increased.

Input about What Needs to Be Done in the Medium Term

First, it is necessary to raise awareness about innovation and entrepreneurship among both educators and learners. It can be ensured that people who are competent in the field are trained in the academy for providing support to the trainer. The continuity of short-term connections and collaborations with external stakeholders should be ensured in the medium term. Universities should not be disconnected from the field and society. The student should also be trained for their needs. For this, a development-oriented approach must be adopted by the universities. E.g., The number of laboratories can be increased, master's and doctoral theses on entrepreneurship and innovation can be assigned...

Views for What Needs to Be Done in the Long-Term

What academics should prioritize is: to provide students gaining skills in programming. For example, instead of listening to ordinary lessons with ready-made materials prepared by someone else, students should be allowed to make connections between courses and subjects programs in education faculties need to be updated for better practices and addressing current needs. Even though the aim is to educate students, the issue of training academics who educate teachers should also be taken seriously. Continuity should be ensured in educational training During the course content creation, external holders should also be taken into consideration

The organization of workshops, seminars, and congresses on innovation and entrepreneurship should be supported for spreading awareness. In this way, universities will become more productive institutions that are fully open to the public, connected to the industry, and cooperating with external stakeholders. With these collaborations, students will take on more active roles in the field, and it will be inevitable for universities to renew themselves.

Discussion

Discussion on Concept Knowledge

According to the research findings, the concept of STEM is generally thought to be developing creative solutions for complex problems and it is a suitable concept that provides opportunities for production by making discoveries. However, when the components included in the definitions were examined, the differentiation in opinions becomes clear. This also proves that STEM educators, experts researching these field, and non-governmental organization officials do not have a consistent understanding of STEM education. Education researchers claim that teachers also have difficulty in establishing connections between STEM disciplines (Kelly & Knowles, 2016). STEM is a concept that consists of the initials of science, mathematics, technology, and engineering disciplines. This abbreviation was introduced by the National Science Foundation in 1990. In addition, the reason for the unification of the disciplines was shown as a strategic decision to join forces and create a stronger political voice by scientists, technologists, engineers, and mathematicians" (STEM Task Force Report, 2014, p.9). However, when it comes to STEM education, these basic areas need to be made more functional and an integrated STEM education framework needs to be introduced (Abell & Lederman 2007; Sanders 2009; Wang et al., 2011). There are still many uncertainties about STEM education and how it should be implemented most effectively (Breiner et al., 2012).

Within the scope of the research, the concept of innovation was expressed as "what is done for the problems that arise within the scope of the need". All groups stated that the starting points of innovative ideas are the problems faced by the individuals. There was a difference between the groups in terms of coming up with original solutions. The important first step in developing our understanding of innovation is to determine exactly what is meant by this term. Most organizations today still find innovation difficult and cannot fully define it although innovation has become a common term. One reason may be that many of the statements about innovation contribute to misunderstanding. It is necessary to admit that innovation is a result, process, and mentality to truly define innovation and benefit from its benefits (Kahn, 2018). This shows that innovation is not only about innovative thinking and an innovative product. To make a full conceptual definition of innovation, “who and what we conceptualize as innovative”, “what are the behavioral patterns labeled as innovation”, “frequency of innovation” and “contribution of innovation to cumulative culture” should be considered as a whole (Carr et al., 2016).

Nearly two decades have passed since the concept of the ‘entrepreneurial university’ has become popular in the academic literature (Etzkowitz et al., 2000). More recently, a university campus has been praised as the key locus of entrepreneurial ecosystems (Miller & Ács., 2017). Nonetheless, some fundamental gaps remain in our understanding of the ability of universities to set the appropriate conditions for academic entrepreneurship and on the adherence of universities with activities that go beyond teaching and research activities. This is particularly worrisome for the context of developing countries, where initiatives often try to emulate strategies applied in advanced economic systems without the provision of similar contexts. The concept of entrepreneurship has been defined as the work done for the problems that arise within the scope of need. Also, the concept is mostly explained concerning innovative products. We fail to fully address and explain the concept because we usually use the word entrepreneurship in different ways. Gartner (1990) in his research, developed a one-page questionnaire asking for a definition of entrepreneurship. This questionnaire was sent to academic researchers, business leaders, and politicians for definitions. In the research, the concept of entrepreneurship has been associated with the concepts of enterprise, innovation, organization creation, value creation, growth, and uniqueness, but a clear definition has not emerged. The challenge is that entrepreneurship has many definitions and connotations. Davidsson (2016) proposes an expression of the entrepreneurship concept as competitive behavior that guides the market process or promotion of new economic activities leading to change in the market. Although we are increasing the number of such definitions with literature support, it is widely accepted that there is no single unified and accepted definition for the term "entrepreneurship" (Gedeon, 2010). When the findings of the research were examined, it is seen that the current examples of entrepreneurship are mostly software projects. In most of the examples given, it is striking that the person making the venture makes a profit. However, social entrepreneurship is based on the fact of creating social value rather than pursuing profit. This is proof that the examples given within the scope of entrepreneurship are in contradiction with them.

Higher Education Institutions can stimulate faculty behavior in this regard. One might argue that these institutional frameworks are oriented towards promoting entrepreneurial intentions in students, rather than in faculty members, but recent evidence also does not support this claim (Alves et al., 2019).

Regarding the concept of Industry 4.0, no common opinion was found within the working group. This is thought to be because this is a new concept. In the definitions, it is seen that the concepts of the internet of things and production are expressed predominantly. These are the main components of the Industry 4.0 concept. Also, the examples given are that autonomous technologies are associated with industry 4.0. It is seen that industry 4.0 represents the fourth industrial revolution when the literature is examined. It is also known that this concept emerged as a part of the High

Technology Strategy 2020 Action Plan by the German government in 2013 (Xu et al., 2018). Although a clear definition of the concept is not revealed, it can be said that Industry 4.0 consists of three structures: the internet of objects, the internet of services, and cyber-physical systems.

Experts in the working group, specifically the ones working in the field of engineering mostly talked about systematic processes. Educators have described the starting point of the concept of robotics as nature in defining the concept of robotics. The examples are given to associate the concept of robotics with robots. It is not surprising that robotics is interpreted differently in different fields, because nowadays, robotic systems which find a wide usage environment from production to our social life, are actively used in teaching. Robotics is defined as an interdisciplinary field that includes robot technologies, which are the result of collaborative work of mechanical engineering, electrical engineering, space and defense systems, programming, and computer technologies in the TÜBİTAK university entrepreneurship and innovation competition / robot development project report (Korkusuz, 2016). In addition, automation systems like water clocks and doorbells played a role in the emergence of the concept of robotics. When these definitions and explanations were examined in detail, it can be inferred that robotics is not only related to the robot. Different and innovative examples of medical robotics, rehabilitation robotics, underwater robotics, field robotics, construction robotics, and humanoid robotics are increasing day by day (Garcia et al., 2007).

It has been determined that the concept of coding is associated with software languages. It is also seen that the definitions are associated with algorithms and mathematics. When the examples were examined, it was found that the experts working in the field of engineering brought the software to the foreground, however, the science group considered the concept in an educational context. It was observed that the findings of coding concept overlap with the concept of robotics. It turns out that the concepts of robotics and coding differ according to the experiences of the people involved in the research process. The two concepts are defined together rather separately by some authorities because coding and robotics have emerged as the most up-to-date subjects among 21st-century skills (Knight, Wright & Freese 2019). In this study, it was noticed that the study group mostly tried to associate these two concepts with each other and wanted to approach the process as "robotics and coding". But in general, coding provides interaction between computers, mechanical devices, and other technological tools and humans. Also, it is expressed as the whole series of commands written to perform certain tasks according to the process steps (Holton, 2007; Richardson & Urbanke, 2008; Sayın & Seferoğlu, 2016).

When the concept of the maker is examined, it is seen that some groups refer to people and some of them express the creation of a product. On the other hand, the examples have completely revealed the products. The maker emerged in the world as a movement and the "Maker Movement" is shown as a community of people, mechanics, engineers, hackers, and artists who creatively design and build projects for both fun and useful purposes (Martin, 2015). Maker movement is also defined as individuals' creating a prototype or product by coming together in formal or informal environments with the "do it yourself" culture (Johnon et al., 2016). In recent years, there has been a growing interest among educators to translate this concept specifically into K-12 education to improve opportunities to participate in STEM applications. For this reason, the concept is mostly mentioned in the field of education, and the people who design projects are defined as makers.

Although there is no common point regarding the concept of artificial intelligence, all software that imitates the human mind and behavior is referred to as artificial intelligence. When we look at the definitions of artificial intelligence in the literature, it is seen that it is defined as a science that has just begun to mark our age or an important technology that supports daily social life and economic activities (Lu, Chen, Kim & Serikawa, 2018). Science fiction generally depicts artificial intelligence as robots with human-like features (IBM Watson, 2017). When the definitions and examples within the scope of the research were examined in detail, it can be said that science fiction shapes the concept of artificial intelligence in our minds. In the definitions made within the scope of the research and in most of the examples given, it is seen that the software compatible with humanoid features is brought to the fore.

Results Regarding the Current State of Entrepreneurship and Innovation Capacity at the Universities and Especially in Education Faculties

The most important finding revealed by the participants is the lack of implementation in education faculties. The literature on innovation and entrepreneurship in universities is increasing day by day. Although the terms in question are commonly used together, there is almost no attempt at the theoretical and practical levels to evaluate them together (Schmitz et al., 2017). Innovative practices developed in the education system contribute to the professional competence of students by supporting their knowledge, skill, and ability development. Teachers and academics are the key people who can contribute to the competencies of students, unleash their creative potential, and take part in the formation of this rich spectrum (Ferrari et al., 2009). It was stated by the participants that academics from education faculties and teachers who graduated from those faculties were inadequate to practice in the field of innovation and entrepreneurship. The reason for this is an opinion that the courses on innovation and entrepreneurship that were given in education faculties are far from being applicable. It was also emphasized by the participants that the studies of academics in education faculties are generally theoretical studies and their practical studies are insufficient. A study by Akdeniz (2020) also found that there are few studies on innovation in the field of education and training. Theses with innovation content were examined by Akdeniz (2020) within the national thesis center as of February 2020. It was stated that only 10 of the 979 theses prepared in this field were made in the field of education and training. However, entrepreneurship and innovation issues should particularly concern the field of education and training. The entrepreneurship education which students received at the university contributes to the students (Galloway et., 2015). Entrepreneurship and innovation are life skills, a dynamic vision, a process of creating change and development (Kuratko & Hodgetts, 2004). However, the participants stated that the courses on entrepreneurship and innovation offered at the university are not courses with application content. In this way, the appropriate teaching of the information included in certain lesson plans may not be possible with non-dynamic textbooks. One of the main reasons why the contents of these courses are not suitable for application in the field is the insufficient stakeholder cooperation. It was stated that there is no cooperation with the companies where the applications are made even in universities with techno parks. As universities continue to produce only theoretical content in isolation from their application areas, the concepts of innovation and entrepreneurship will not go beyond the level of knowledge and awareness.

Results Regarding the Short, Medium, and Long Term Need to Be Done for Increasing the Entrepreneurship and Innovation Capacity in Universities Especially in Education Faculties

It was stated that practical course contents that stimulate creative thinking skills should be created about innovation and entrepreneurship in the short term. In addition to the contents of these courses, the importance of providing physical environments such as laboratories and workshops where these courses can be carried out was mentioned. Innovative practices developed in the education system contribute to the professional competence of students by supporting their knowledge, skill, and ability development. Teachers and academics are the main people who will contribute to these competencies of students, unleash their creative potential, and take part in the formation of this rich spectrum (Ferrari et al., 2009). First, academics and their students are expected to add value to themselves in this context. Participants stated that entrepreneurs and innovative individuals who have developed learning autonomy and creative thinking skills have been educated by establishing connections with stakeholders who actively practice in their fields, directing them to the fields, and establishing connections with the university and industrial sectors, business areas.

In the medium-term, it was stated that the continuity of these collaborations developed in the short term should be maintained. It was stated that the application areas and the continuity of the contacts of the universities, especially the education faculties with the application areas should continue. Entrepreneurship, which is also the key to economic growth has been facilitating innovation and value creation. Entrepreneurship makes a great contribution to STEM and innovation. (Elliott, et al., 2020). It was mentioned that application-oriented field studies should be conducted on innovation and entrepreneurship. Also, support for master's and doctoral theses which are application-oriented is expressed in this area.

In the long term, it is important to develop students' learning autonomy. Adopting an innovative teaching approach to raise individuals who are open to innovations and can keep up with the 21st century has become a necessity for today's teachers (Zhu et al., 2013). Curriculums should be dynamic, and students should acquire the skills of reading these dynamic programs, making connections between courses, analyzing, and synthesizing. Participants drew attention to the use of various approaches, methods, and techniques regarding entrepreneurship and innovation. In parallel with this, it has been stated in the literature that project-based learning, problem-based learning, collaborative learning, group work, discussion, drama, learning by doing-experimenting, workplace application field study trips, and seminars with entrepreneurial individuals can be beneficial in this sense (Morselli, 2019; Pepin & St-Jean, 2019; Seikkula Leino, 2011). In this regard, students, teachers, and academics should be released. Policymakers and decision-makers in the field of education should provide the necessary support to academics, teachers, and students who can implement this situation. Academics' work should primarily be supported for the development of academics in innovative and entrepreneurial studies in the professional sense. Teachers working in schools should be able to get support from the academy whenever they need it, and academics at the university should be able to communicate easily with teachers in the field in their studies. In this way, the connections with the sector should become more transparent and the collaborative work with stakeholders should become more prominent. In this way, students will work on more goal-oriented, application-oriented problems, and they will be discovered more by the sector officials on the application side. In addition to these, university-school-sector meetings should be organized, and they should be supported to bring entrepreneurs and innovation-oriented people together. Entrepreneurial universities make it easier to share knowledge and to commercialize the acquired knowledge (Auretsch, 2014). Entrepreneurial universities that share information contribute to economic and social development thanks to their collaborations and multitasking (Guerrero et al., 2014). In future research, studies can be carried out to eliminate the misconceptions about the concepts in this study; to make common definitions by bringing together different stakeholders as in this study, and to create common content. It is also recommended that STEM concepts be taken into consideration while developing programs at the faculty/department level in higher education institutions. In addition, learning-teaching centers that are/should be in higher education institutions during the development/implementation process of the programs should also provide the necessary guidance and coordination.

Limitations

The results are limited to the opinions of academics, experts, and non-governmental organization officials who voluntarily attended a roundtable meeting at an international conference, İstanbul. The validity of the results could be increased by doing additional interviews and observations with the participants of the meeting.

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