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THE EFFECT OF ENTREPRENEURSHIP EDUCATION MODULES INTEGRATED WITH SCIENCE EDUCATION ON THE ENTREPRENEURIAL CHARACTERISTICS OF PRE-SERVICE SCIENCE TEACHERS

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Abstract

In this research, it was aimed to investigate the effects of entrepreneurship education modules integrated with science education on entrepreneurship characteristics (risk taking, seeing the opportunities, being innovative, self-confidence, and emotional intelligence) of pre-service science teachers. The research was realized in 2013-2014 education years during a selective course with the participation of 26 third grade pre-service science teachers in Turkey. The mixed design was adopted in the research. The qualitative dimension of the research was designed as phenomenological study while

simple experimental method was preferred for the quantitative dimension. The data was obtained through "Entrepreneurship Scale" and semi-constructed interviews. The descriptive analysis was preferred in order to present the data obtained through interview while Wilcoxon Signed Rank Test was used for the data obtained before and after experimental implementation. As a result of the research, it was seen that entrepreneurship education had statistically significant positive effect on risk taking, seeing the opportunities, being innovative, and emotional intelligence characteristics of preservice science teachers, at the same time it was determined through the qualitative methods that it has a positive effect. However there was any statistically significant difference in terms of self-confidence characteristics. According to this results, there can be suggested that entrepreneurship education should be placed in science teacher education and experimental researches should be conducted for other entrepreneurial characteristics. Entrepreneurial characteristics are thought to be acquired through entrepreneurship education and can potentially be acquired through similar education modules. In-service education courses, such as seminars, can be organized for the science teachers who are in service and have not had entrepreneurship education.

Keywords: *Entrepreneurship, Teacher Education, Science Education*

Introduction

Entrepreneurial characteristics are among the most important characteristics that can be gained by students in 21st century (A guide to Enterprise Education, 2009). Regarding the investigation of the approach to entrepreneurship education at the primary education level, no data had been reported for science curriculums in Turkey until 2012 (European Commission, 2012). However, concrete steps have been taken regarding entrepreneurship education in recent years in Turkey and in other countries (Finland, Malaysia, Nigeria etc.). Attempts to ensure that students acquire entrepreneurial characteristics through curriculum at both the primary education and middle school levels can be seen as positive steps.

While entrepreneurship education is narrowly defined as preparing students for the business world, it is also identified as the process by which a number of characteristics that will primarily provide individual, social and economic benefits are acquired. Moreover, people are able to extensively implement these characteristics in every area of their lives (European Commission, 2011). The logic behind entrepreneurship is the enabled characteristics that can be used practically in life by engaging in school and real life knowledge (Antones & Van-Vuuren, 2005; Bikse, 2009; Hannon, 2006; Heinonen & Poikkijoki 2006; Heinonen, 2007; Jones, 2006; Oganisjana, 2006; Wing Yan Man, 2006). It is believed that the acquisition of the characteristics that are required for the market of work power is possible through this manner. Therefore, the idea of entrepreneurship has been described as an individual ability that enables one to convert an idea into an implementation (European Commission, 2011).

Gibb (2005, 2011) stated that the pedagogy implemented in entrepreneurship education needs to be constructed such that the students have an active role. This pedagogy comprises methods and techniques, such as collaborative learning, project studies, practical learning, learning through dairies, drama, entrepreneur implementations, and work place visits (Jones, 2007; Neck & Greene, 2011; Seikkula-Leino, 2011). Rae and Carswell (2001) defined the learning process that enables the development of entrepreneurial characteristics as the implementation of the characteristics and abilities that are necessary to improve and identify the opportunities around an individual. These types of learning processes are dynamic and enable entrepreneurial characteristics to assume an active form. Experiment-based learning is accepted as more effective in the development of entrepreneurial characteristics and attitudes than traditional methods such as lecturing (European Commission, 2008). In this manner, the implementation and intended use of entrepreneurial concepts in education are aligned with the nature of the constructivist learning theory. Understanding is known to be the dominant factor in the transfer of school knowledge into daily life, and engaging school knowledge with life knowledge mostly involves the constructivist approach. This approach serves the same purpose as the knowledge and characteristics that are thought to be acquired in entrepreneurship education. Entrepreneurship education suggests the conversion of objectives and concepts from the curriculum into out-of-school activities. Therefore, the constructivist approach has been stated to be the theoretical background for entrepreneurship education (Löbler, 2006). Students better acquire entrepreneurship characteristics in experiment-based educational environments, as reported in studies from countries that place entrepreneurship at the forefront of education, such as Finland (Seikkula-Leino, 2011), Singapore (San-Tan & Ng, 2006), Sweden (Rasmussena & Sørheim, 2005), and England (Raffo et al., 2000). It has been reported that this approach can improve students' participation, performance, and behavior in courses (A Guide to Enterprise Education, 2009). In this process, students should determine the problems in daily life, and opportunities should be provided for relating school learning to real life. Finally, the products that are formed by benefiting from these opportunities should be usable in practice (Braun, 2008; Gibb, 1993; Wing Yan Man, 2006). According to this explanation, it can be said that entrepreneurship has an important place in science education.

These skills have been purposed to transfer up to the level that enables students to start their businesses after graduation because they have acquired practical skills, problem solving, critical thinking, and communication skills during their high school and university science education (Beca, 2007). Hence, entrepreneurship is seen as a career choice (National Association for the Self-Employed, 2004) because science education prepares students for their future careers. Moreover, the necessity of engaging in entrepreneurship education within this discipline has received much attention (Achor & Wilfred-Bonse, 2013; Beca, 2007). Additionally, having the potential to improve the national development of entrepreneurship characteristics will enable these characteristics to emerged from science education in middle school (Bolaji,

2012). Bolaji (2012) reported that entrepreneurial characteristics can be acquired through science education. Moreover, Achor and Wilfred-Bonse (2013) claimed that the entrepreneurial characteristics of students can easily be developed in technology, physics, biology, and social sciences because the connections between real life and school issues are apparent in science education. Adeyemo (2009) stated that entrepreneurial characteristics can be acquired by students through activities both in and out of class activities and laboratory applications. In recent years, it has been emphasized that the entrepreneurial characteristics of students can be developed through the project design circle (i.e., discovering the problems and necessities, determining the problem and necessities in detail, producing probable solutions, identifying the best solution, creating the first design sample, testing the solutions, communicating with experts about the solution, and redesigning) in STEM (science, technology, engineering, and mathematics) education, which overlaps with science education in terms of purpose (Ezeudu, Ofoegbu & Anyaegbunnam, 2013). On the other hand, Buang and Halim (2007) stated that entrepreneurial characteristics can be acquired by students through the entrepreneurial process (i.e., purposefully observing the environment, exploring the necessities, clearly stating the ideas, choosing one of the ideas, forming a product, testing the product, adapting to the conditions and marketing), which is the next step in the development of science process skills. Deveci and Çepni (2014) proposed the following steps for the entrepreneur project development process for pre-service science teachers by focusing on the deficits in the economic dimension, both in the adopted project design cycle in STEM education and the project development process suggested by Buang and Halim (2007):

- Observe the environment and identify the needs of society
- Suggest entrepreneurial ideas that comprise necessities
- Make decision about one of the entrepreneurial ideas
- Determine whether the idea already exists (similarity analysis)
- Propound the differences of the new product from other similar products (originality)
- Describe the target group (widespread effect)
- Make decisions regarding the necessary materials, tools, services, etc.
- Determine and eliminate the potential risks (plan B)
- Identify the design of the purposed product or service (work analysis)
- Decide on the qualities and the numbers of people needed for production and marketing
- Calculate the cost at the end of the work analysis or design
- Determine the predicted average target sales (per year, per month, per day)
- Predict unexpected conditions
- Decide how to reach the customers
- Make decisions regarding the types of channels used for advertising
- Presenting the project in a report form

Many researchers agree with the idea that entrepreneurial education should be an integrated part of science education and that various activities that draw attention to the project processes need to be included. Information about the types of characteristics that can be developed through these types of activities and entrepreneurial projects is presented below.

Entrepreneurial characteristics have been categorized in many different ways. However, the most attractive characteristics are **risk taking**, **being innovative**, **self-confidence**, **considering the opportunities**, and **emotional intelligence.** These characteristics comprise factors such as success requests, motivation, controlling one's emotions, making decisions, and self-control (Corbett & Hmieleski, 2005; Hisrich et al., 2005; Zhao et al., 2005; Zakarevičius & Župerka, 2010). People with **emotional intelligence** need to be aware of their own emotions by motivating themselves, and they need to have social skills and empathy (Goleman, 2011). It has been suggested that success in all occupations is related to emotional intelligence (Boyatzis, Goleman & Rhee, 2000). Additionally, a positive relationship has been identified between being a good teacher and emotional intelligence in education (Palomera, Fernandez-Berrocal & Brackett, 2008). **Being innovative** is considered to be one of the most important characteristics of a successful entrepreneur. Additionally, this characteristic is closely related to the target definition, and it can be improved in creative manners by considering the requirements of society and demands of the market (Dolgun, 2003). Carolyn (2000) stated that students can acquire some characteristics to improve innovative plans via entrepreneurship education. The education reforms in Singapore involve efforts to improve the innovation of teachers (Ng, 2007; 2010). The characteristic of **considering the opportunities** has been interpreted as making investments in fields that will potentially elicit benefits by considering the emerging opportunities of the present and the future (Ulaş, 2006). Indeed, being aware of opportunities and creating opportunities from the foundation of entrepreneurship (Shane & Venkataraman, 2000). Therefore, considering opportunities is enormously important for teachers, and one of the responsibilities of teachers is to create opportunities for learning during the education process (Johannisson, 2002). **Self-confidence** begins with a feeling of trust, a person first needs to feel self-confident in order to step into the professional life (Bakan, Eyitmiş, Büyükbeşe & Erşahan, 2012). To successfully conduct the activities of an organization after recruitment, the need for self-confidence in terms of timing, quickly processing knowledge, and handling the tasks has been emphasized (Napier et al., 2006). Some of the chapters in science education have important effects on the self-confidence of pre-service teachers (Appleton, 1995). **Risk taking** is accepted as a precondition for entrepreneurs (Macko & Tyszka, 2009). It has been stressed that entrepreneurs should always intend to take risks in situations that provide profits (Koh, 1996). However, educational institutions do not promote risk-taking in students (Palmer, 2003). Additionally, it has been stated that some activities during teacher education are directed toward breaking the

courage of pre-service teachers in terms of risk-taking (Clayton, 2007). Therefore, the stated characteristics are important for and should be possessed by pre-service science teachers.

A theoretical study of entrepreneurship in science education performed by Deveci and Çepni (2014) revealed that explanations about how entrepreneurship education needs to be utilized from different dimensions (i.e., pedagogy of entrepreneurship education, the learning environment, and the roles of the educator and the student in entrepreneurship education) should be included in science education. In another theoretical study conducted by Adeyemo (2009), some strategies for the identification of entrepreneurial characteristics, the acquisition of entrepreneurial characteristics, making teachers entrepreneurs, and the development of entrepreneurial characteristics in pre-service science teacher education were highlighted. Bolaji (2012) investigated the views of science teachers regarding engaging the entrepreneurship education in science curriculum in the Nigerian education system, and concluded that science teachers hold positive perceptions of engaging in entrepreneurship education. Baranović, Stibric and Domovic (2007) investigated the views of teachers about their proficiency in understanding issues related to entrepreneurship and the adaptation of those proficiencies into compulsory education. In this study, the majority of the teachers stressed that proper education was not provided in schools in terms of teaching entrepreneurship, and they also stressed the necessity of such education to gain expertise related to issues of entrepreneurship, teaching skills, and practicing new methods. Buang and Halim (2007) suggested numerous manners in which to understand curriculum development and implementation as well as the views of the participants; these authors highlighted the necessity of these types of characteristics in their research, which advocated for the development of new science and technology curricula based on entrepreneurial science thinking skills in Malaysia. The research findings present a strong base on which to develop an alternative science and technology curriculum that depends on technology, science processing skills, and entrepreneurial characteristics. Buang, Halim and Meerah (2009) concluded that science processing skills are compounded with entrepreneurial thinking in development of science-based innovative products from the perspective of research conducted with participants in graduate level education. Seikkula-Leino (2011) conducted research related to the development of entrepreneurship education in local education reforms in 2005 on the initial stages and the implementation processes of entrepreneurship education, and in 2006, these authors examined the second stage of this process. In this research, the participants (teachers, advisors, principals, education authorities, office owners, and market and industry authorities) took responsibility for entrepreneurship education rather than utilizing different implementations in municipal and local units. Again, the teachers in the field of education in this study stated that they strengthened themselves regarding entrepreneurship education; however, the participants in the other fields were not optimistic about the future of

entrepreneur education. Bacanak (2013) stated that teachers do not have the necessary knowledge about entrepreneurship education and that a common understanding of student-centered methods and techniques can be effective in the development of entrepreneurial characteristics. This research was conducted to investigate the effects of science courses on the entrepreneurial characteristics of 6th, 7th, and 8th graders. Yavari, Heydarinejad and Habibi (2013) concluded that special courses provided in physical education curriculums had no effect on the development of entrepreneurial characteristics in their research that investigated the effects of courses provided to pre-service physical education teachers. Souitaris, Zerbinati and Al-Laham (2007) concluded that students exert a positive effect on entrepreneurial activities directed at self-employment based on research that employed a quasi-experimental method to identify the effects of entrepreneurship education on the entrepreneurial activities and attitudes of science and engineering students.

In the above-mentioned studies, it can generally be observed that teacher perspectives regarding the inclusion of entrepreneurship in science education are important (Bolaji, 2012; Baranović, Stibric & Domovic, 2007; Bacanak, 2013; Seikkula-Leino, 2011). Additionally, theoretical research regarding the importance of entrepreneurship in science education has been conducted (Adeyemo, 2009; Buang & Halim, 2007; Deveci & Çepni, 2014). The need for long-term experimental studies has attracted attention to the development of the entrepreneurial characteristics of pre-service science teachers. Therefore, it can be concluded that there is a need for experimental studies of the development of the entrepreneurial characteristics of pre-service science teachers.

In Turkey, entrepreneurship is placed among the life skills that students need to acquire in the new science curriculums at national scale (Ministry of Education, 2013; 2017). At international scale, it was emphasized that the links between science education and entrepreneurship should be strengthened (European Commission, 2015; Deveci & Çepni, 2014). In this sense, Bolaji (2012) suggested that processes that will lead pre-service science teachers to efforts to increase entrepreneurial activities need to be implemented. But, no guide that aided the development of these characteristics for teachers was included in the curriculum. The deficits in these characteristics are more definite in the pre-service teachers who are going to teach science courses, including science, technology, and society. Teachers play an important role in the acquisition of entrepreneurship education (Birdthistle et al., 2007; Deakins et al., 2005; European Commission, 2013; Seikkula-Leino et al., 2010) and the development of entrepreneurial understanding (European Commission, 2013). Because teachers do not receive entrepreneurship education as part of the undergraduate or continuing education, they are unable to prepare materials for the development of entrepreneurial characteristics (European Commission, 2013; Seikkula-Leino et al., 2010). In a different study, teachers were found to experience problems finding methods and content during the stage of transferring the entrepreneurship concept

into practice (Fiet, 2000a, 2000b; Seikkula-Leino, 2008; Solomon, 2007). The teachers' lack of the sufficient proficiency is an important problem for the implementation of entrepreneurship education; therefore, teachers exhibit deficits in terms of entrepreneurial characteristics (European Commission, 2009). For example, it has been suggested that the issues surrounded by the most apprehension in terms of the concept of entrepreneurship that is included in curriculums in Malaysia is whether the teachers feel that they are required to have entrepreneurial characteristics (Bakar, Pihie, Akmaliah, Konting & Angking, 2001). Recently, the need for quality entrepreneurial teacher education has been considered (European Commission, 2013). Additionally, a lack of awareness of many teachers regarding the true approach for implementing entrepreneurial education was noted and likely due to the teacher not receiving education about entrepreneurial education (European Commission, 2009). These shortcomings indicate that the entrepreneurial training modules developed for pre-service teachers are important. In this sense, it has been suggested that entrepreneurship education should be included in all pre-service teacher education curriculums (Bakar, Pihie, Akmaliah, Konting & Angking, 2001). Furthermore, it has been stated that self-confidence, working independently, and developing problem solving characteristics are among the entrepreneurial characteristics that can be developed (Karakuş, 2007), and risk-taking characteristics can also be developed (Shulman & Tamir, 1973) through experimental methods.

The aim of this research is to examine the effects of entrepreneurship education on the entrepreneurial characteristics (i.e., risk taking, self-confidence, being innovative, considering the opportunities, and emotional intelligence) of pre-service science teachers. In accordance with this purpose, **research problem** is how entrepreneurship education modules integrated with science education will reflect on the entrepreneurial characteristics of pre-service science teachers? **Sub-problems** of the research are:

How entrepreneurship education modules integrated with science education will reflect on the risk taking characteristics of pre-service science teachers?

How entrepreneurship education modules integrated with science education will reflect on the characteristics of self-confidence of pre-service science teachers?

How entrepreneurship education modules integrated with science education will reflect on the characteristic of being innovative of pre-service science teachers?

How entrepreneurship education modules integrated with science education will reflect on the characteristic of considering the opportunities of pre-service science teachers?

How entrepreneurship education modules integrated with science education will reflect on the characteristic of the emotional intelligence of pre-service science teachers?

1. Research methodology

The mixed design approach was used in the research. Cresswell (2008) describe the mixed design as the qualitative and quantitative data collection and analysis procedure at the stages of the related research procedure in order to understand the whole research problem. In mixed method, it was stated that researcher collect quantitative data through questionnaire and qualitative data through text to better solve the research problem (Heigham & Croker, 2009). The mixed embedded method approach among the mixed method approaches preferred for this study since qualitative data gathered through experimental approach and compared through quantitative data (Creswell & Plano Clark, 2011). In the mixed embedded approach, both qualitative data can be supported through qualitative data which was embedded into and can be supportive for statistical results in order to clear some questions which are not able to be responded with experimental or comparative researches in qualitative data (Ary, Jacobs, Sorensen & Razavieh, 2010). For this study, while the quantitative dimension was designed as simple experimental method, qualitative dimension was designed as phenomenological study.

Phenomenological Research: Phenomenology generally interests with the person who get experience in specific time and context rather than abstract view of world. Therefore, phenomenology is related in cases that we are aware of in the world that we are in interaction (Willig, 2008). The phenomenological researches are the researches which designed in order to identify the experienced experiences by the people who participated to the research in addition to explain and interpret this experience (Ary, Jacobs, Sorensen & Razavieh, 2010).

Simple Experimental Method: In this study, simple experimental method was preferred since there is not any other course (not to have control group) overlap with the purpose and content of entrepreneurship education. In the simple experimental method, researcher manipulates the group and working on single group. In this method, there is no control group that the researcher is able to make comparison (Cresswell, 2009). Therefore, the one group pre-test and post-test design which is common in educational researches was used in this study (Ary, Jacobs, Sorensen & Razavieh, 2010; Campbell & Stanley, 1963). This design was implemented in three steps. The pre-test was implemented (O1) to the group at first stage, making manipulation using education modules at the second stage, and post-test implementation at last.

Group A: 01 ⟶ Education Modules ⟶ 02

This experimental design has the lowest internal validity. The effect of the variables such as development and maturation were pointed out while it was stated that it is hard to cite the difference between the pre-test and post-test results. In this method, another remarkable weak point is possible improvement situation since the implementation of the pre-test for the second time (Ary, Jacobs, Sorensen & Razavieh, 2010; Campbell & Stanley, 1963). The mixed method was especially preferred in order to overwhelm the weak points and interviews were planned after test implementation.

Participants: Twenty-six pre-service science teachers who enrolled a selective course participated in this study. There were no selection criteria for these participants, and they were randomly assigned. Twenty-one of the participants were female, and five were male. The average age of the participants was twenty-one. Nineteen of the participants were juniors and, four were seniors. The other three participants were outside of the normal educational process (fifth and sixth grades).

***Implementation Process*:** The study was conducted during a three credits selective course provided in 5th semester of the pre-service science teachers in University in 2013-2014 academic years. 26 pre-service science teachers participated in the study. 21 of the participants were female and 5 were male students. The average age range of these participants was 21. In implementation process of this study was used entrepreneurship education modules integrated with science education which is developed by researchers. The entrepreneur project development process which is suggested was benefited during the implementation of this course as well. The stages of this process listed in table 1.

Table 1: *Entrepreneurship education modules integrated with science education*

Modules	Aims
Module 1	To introduce skills included in middle school science education curriculum *To provide observe the environment and identify the necessity of society
Module 2	To explain concepts of entrepreneur, entrepreneurship, entrepreneurial characteristics entrepreneurship education. *To evaluate suggested entrepreneur ideas comprising necessities
Module 3	To clarify importance of entrepreneurship education in science teacher training *Make decision on one of the entrepreneur ideas alleged by participants
Module 4	To explain the entrepreneur project and to reveal the difference from other types of projects *Determine if the idea is already existing (similarity analysis)
Module 5	To ensure having information them about how to improve entrepreneurial characteristics of middle school students in science courses *To propound the differences from the other similar products (originality)
Module 6	To examine activities included in science curriculum in terms of entrepreneurial characteristics in general (risk taking, seeing the opportunities, being innovative, self-confidence, and emotional intelligence) *Describe the target group (widespread effect)
Module 7	To investigate activities possible to develop characteristics of risk taking included in middle school science curriculum *Make decision on necessary material, tool, service, etc.

Modules	Aims
Module 8	To investigate activities possible to develop characteristics of seeing the opportunities included in middle school science curriculum *Determine the possible to encounter risks and elimination (plan B)
Module 9	To investigate activities possible to develop characteristics of being innovative included in middle school science curriculum *Identify the design of purposed product or service (work analysis)
Module 10	To investigate activities possible to develop characteristics of self-confidence included in middle school science curriculum *Deciding on quality and number of person who will have task in production and marketing
Module 11	To investigate activities possible to develop characteristics of being emotional intelligence in middle school science curriculum *Calculation of the cost at the end of work analysis or design
Module 12	To examine activities developed by participants towards to improve entrepreneurial characteristics of middle school students in science course -1 *Determination of prediction average target sale (per year, monthly, daily) and Making prediction on unexpected condition
Module 13	To examine activities developed by participants towards to improve entrepreneurial characteristics of middle school students in science course - 2 *Making decision on how to reach to customer and Making decision on advertising through what kinds of channels
Module 14	*Presenting the project in a report form

*Stages of the entrepreneur project development process

Each of these stages was implemented in one week with the exceptions of the first four stages, which were conducted over two weeks. The pre-service science teachers prepared their projects in groups of 3-4 people. In the project, each stage was assigned as a task for the next week. The projects were presented each week by a presenter who was selected from the members of the group. During this process, the researcher provided theoretical information about issues such as entrepreneurship education, the entrepreneurial project development process, and sample entrepreneurs according to the topic of that week. This information was presented by the researcher for approximately 20 minutes each week. The students then gave 15-minute long presentation in class about the level of their project that they had completed that week. During the presentations, in-class discussions were held about the missing parts of the project and how the project could be improved. Sample project titles from the students' presentations are listed below.

Group 1: "Portable Dress Cabinet"
Group 2: "Vacuum Bag"
Group 3: "Space Model for Middle Schools"
Group 4: "Organic Cream from Quince Seed"

Data Collection Tools: The data for this study were obtained through interviews and an entrepreneurship scale that the pre-service science teachers completed. Detailed information about the data collection tools presented below.

Entrepreneurship Scale: The Entrepreneurship Scale towards Teacher Candidates (ESTC) was developed by Deveci and Çepni (2015). This scale was applied to 730 pre-service science teachers who were selected via a criterion sampling method from the science education departments of five state universities in the 2013-2014 academic year. Confirmatory and exploratory factor analyses were conducted to construct the factor structure, which was composed of five subscales. At the end of the research, the loading factors belonging to the subscales ranged from 0.51 and 0.79, and the total item correlations ranged from 0.35 to 0.68. The minimum eigenvalue belonging to a subscale was 3.00, and the minimum variance rate was 41%. The five-factor structure was validated with respect to the compliance values of the confirmatory factor analysis. The reliability of the research was assessed with Cronbach's alpha, and the test-retest method. The minimum Cronbach's alpha reliability coefficient was 0.77, and the minimum correlation coefficient was 0.66 for the test-retest technique. Based on these results, the ESTC, which is composed of risk taking, being innovative, self-confidence, considering opportunities, and emotional intelligence subscales, is reliable and valid.

Interview Form: Initially, a sketch form was composed to develop the interview form. The questions in the sketch form were reviewed by three academics (two were experts in measurement and one was an expert in science education). The questions were composed according to the views and suggestions of experts and presented to three of the pre-service teachers who then provided suggestions and feedback regarding any difficult to understand points. Finally, the implementation stage was performed after decisions regarding the questions were made. The five main questions included in the interview form are presented below:

1. What do you understand regarding entrepreneurship?
2. What types of characteristics do you think entrepreneurial people should have?
3. What are the entrepreneurial characteristics that you think you have?
4. What are the entrepreneurial characteristics that you think you do not have?
5. Do you think that entrepreneurship education contributions to the improvement of your entrepreneurial characteristics?

Additional questions were asked to keep the pre-service science teachers focused on the interview topic and acquire more detailed responses. Each interview with the participating pre-service science teacher was approximately 20 minutes long.

Data Analysis: Before and after the experimental implementation, the Wilcoxon signed-rank test was used to analyze the data obtained from the entrepreneurship scale. The Wilcoxon test was used to analyze the results of the two measurements performed within a specific time period using the same variable (Connolly, 2007). Descriptive analyses were performed to analyze the qualitative data that were obtained from the interviews. For this process, all of the data from the interviews were first recorded and transcribed into a word document. Next, the data were examined, and data not relate to the research problem in this text were excluded. Before performing the complete analysis operations, the researcher read the data repeatedly in accordance with the research purpose. Next, the views of the pre-service teachers regarding the related issue were gathered under defined themes based on considerations of the issues of this research. In this manner, the data were explained by making direct citations under defined themes.

To ensure the reliability and validity, which are the weak aspects of qualitative research, the data reflecting the findings were presented to five of semi-interviewed pre-service teachers, and their opinions were recorded regarding whether their explanations and the intended issues were related. Additionally, another researcher suggested text-dependent interpretations, and it was understood that the meanings paralleled the interpretations formed by the researcher during the data analysis. This process was performed to test the acceptability of the interpretations depending on the text.

The compliance with research ethics: This article is based on scientific rules and scientific values. Thus, for methods, data, articles and figures used in this research cited to their owners. Moreover, all of the data, without addition or distortion, are the opinions expressed by the participants. In acknowledgment section also mentioned the institution that supports this research. Both the authors were actively involved in research process from the beginning to the end. In addition to, the survey was conducted on students voluntarily taking elective courses. The students were certainly not forced, and education modules have no effect on students‘ academic achievement.

2. Research results

The qualitative and quantitative research findings detailed here were obtained as the result of the analysis of the research data.

2.1. Results obtained from the quantitative data

Here, the findings obtained from the quantitative data and the findings from the Wilcoxon signed-rank test are detailed to explain the effects of entrepreneurship education on the entrepreneurial characteristics of the pre-service science teachers.

Table 2. *Comparison of the tests taken by the pre-service teachers before and after the entrepreneurship education as analyzed with the Wilcoxon signed-rank test*

Scale/ Sub-dimensions	Post Test-Pre Test	N	Mean Rank	Total Rows	z	p
Total	Negative Ranks	5[a]	12,20	61,00	-2,732[b]	,006
	Positive Ranks	20[b]	13,20	264,00		
	Ties	1[c]				
	Total	26				
Risk Taking	Negative Ranks	7[a]	7,29	51,00	-2,021[b]	,043
	Positive Ranks	13[b]	12,23	159,00		
	Ties	6[c]				
	Total	26				
Self-confidence	Negative Ranks	8[a]	9,63	77,00	-1,615[b]	,106
	Positive Ranks	14[b]	12,57	176,00		
	Ties	4[c]				
	Total	26				
Seeing Opportunities	Negative Ranks	9[a]	7,78	70,00	-2,496[b]	,013
	Positive Ranks	16[b]	15,94	255,00		
	Ties	1[c]				
	Total	26				
Being Innovative	Negative Ranks	4[a]	9,63	38,50	-3,045[b]	,002
	Positive Ranks	19[b]	12,50	237,50		
	Ties	3[c]				
	Total	26				
Emotional Intelligence	Negative Ranks	7[a]	8,79	61,50	-2,336[b]	,019
	Positive Ranks	16[b]	13,41	214,50		
	Ties	3[c]				
	Total	26				

According to the data presented in Table 2, the entrepreneurship education exerted generally positive effects on the entrepreneurial characteristics of the pre-service teachers. There was no statistically meaningful difference in the self-confidence dimension when examined in terms of each of the dimensions included in the scale. In contrast, according to these findings, the provided entrepreneurship education exerted positive effects on the risk-taking, considering the opportunities, being innovative, and emotional intelligence characteristics of the pre-service science teachers.

2.2. Results obtained from the qualitative data

In this section, the entrepreneurship characteristics that the pre-service teachers believed that they had before and after the implementation are described. Additionally, the perspectives of the teachers regarding whether the provided education affected them are considered. Similarly, the qualitative data obtained through the interviews are described based on descriptive analyses.

Before beginning the implementation, the interviews were conducted without providing any information about entrepreneurship, entrepreneurship education, entrepreneurial characteristics, or entrepreneurship in teacher education to the pre-service science teachers. The lack of information and experience of the pre-service science teachers was attended to during the pre-interviews. To identify the differences and avoid leading the pre-service teachers, interviewer avoided providing any interpretations about entrepreneurial characteristics during the pre-interviews. Generally, the pre-service science teachers listed self-confidence as the entrepreneurial characteristic that they possessed during the pre-interviews. Examples are provided below.

Participant 1: "*I think about the point of self-confidence in terms of these characteristics. I don't confidently talk much in society. About my word choices, I can try to convince someone in case I have enough information only if I believe in that is true too. Maybe only this characteristic of mine fits with entrepreneurship.*"

Participant 2: "*I think that I have self-confidence among the entrepreneurship characteristics. I have some special interests, I follow them. I wonder and read.*"

Additionally, the pre-service teachers perceived that they curiously performed research in the field that they were interested in and felt that curiosity was an entrepreneurial characteristic. Examples are provided below.

Participant 3: "*I am a little bit curious. I like to apply my learning to daily life. I like to search for interesting things. I want to have at least one or two words to say on any issue.*"

Participant 2: "*I have different areas of interest, I follow them. I wonder and read. The most dominant entrepreneurial characteristic of my mine is inquiring about things in my area of interest.*"

As observed from these examples, the pre-service teachers believed that they conducted research about issues that interested them and that curiosity was an entrepreneurial characteristic. Another attractive point came from a statement of a teacher candidate that they not see him/herself as an entrepreneur.

Participant 4: "*I behave a little bit shyly. I don't think that I am an entrepreneur. I am a little bit nervous and panic. I want to do it instantly. Those are my personal characteristics. Indeed, that is a bad thing.*"

In contrast, some of the pre-service teachers stated that they were not aware of the types of entrepreneurial characteristics or suggested some qualifications other than basic entrepreneurial characteristics and did not have information or experience regarding entrepreneurial characteristics. Examples are provided below.

Participant 5: "*I trust in myself, I am determined and successful. I have lots of characteristics, but I don't know which of my characteristics can be included among entrepreneurial characteristics. For example, I am helpful.*"

Participant 6: "*I am a fairly good at improvising. I like to add some color to the atmosphere. I can even exaggerate an event. I have an intrinsic character.*"

Participant 7: "*I like participation. I can make predictions and make conclusions based on my previous experience. I can provide solutions. I can focus on different areas. I was a more active student in my high school years; let's do that, let's change this. I always suggest something to the school management.*"

During the interviews that were conducted with teacher candidates, the pre-service teachers strained to evaluate themselves in terms of whether they possessed entrepreneurial characteristics because they lacked knowledge about basic entrepreneurial characteristics.

2.3. Data obtained from the post-interviews

After the education process, the pre-service teachers were better able to define themselves in terms of entrepreneurial characteristics. Examples are provided below.

Participant 9: "*Obviously, I think that I am not an entrepreneurial person. I can afford to take any risk. In addition, I guess entrepreneurship requires being patient. I am impatient, in other words, I don't have that but I can be innovative. I can adapt to change. However, I can't say that I am an entrepreneurial person who can make something from nothing.*"

Participant 11: "*I don't much like to take risks. But, I think that I have leadership qualities in a group and that I am an open-minded person regarding innovations. Also, I don't have the characteristic of considering the opportunities. I can't evaluate the opportunities around me.*"

Participant 2: "*When I have hard times, my creativity can take over among the characteristics of entrepreneurial persons. Additionally, I have a little bit of trouble letting innovative ideas take over. Indeed, I took risks during the times in my life in which I needed to take risks. So, those three especially take over.*"

From the examples, it can be observed that the pre-service teachers thought better of themselves compared to their opinions during the pre-interviews in terms of entrepreneurial characteristics. Outstandingly, they stated more conscious and exploratory views about whether they had entrepreneurial characteristics. The pre-service teachers provided more detailed information about the entrepreneurial characteristics that they believed they had and how those characteristics were improved after they had undergone the entrepreneurship education. Similar effects were observed regarding **risk-taking** as shown in the examples below.

Participant 7: "*My risk taking characteristics were improved after this education. Before this, I had no idea about taking risks. Now, I have learned that risk-taking can*

be learning in some activities. Or I can learn not only as lessons but in other forms such as projects."

Participant 12: "*It can be taking risks. Before, I was afraid to take risks. Now, I have learned that risks can be taken if it is necessary. Thus, I think that I need to take risks even if they bring good or bad results.*"

As illustrated by these responses, the pre-service teachers clearly what risks need to be taken in life. Similarly, the provided education formed a consciousness of risk-taking in the pre-service teachers. The pre-service teachers also mentioned the characteristic of **being innovative** in their views.

Participant 7: "*Regarding the characteristic of being innovative, I have begun to look at events a little bit differently and with a range of views. What can be done about creativity? I have never thought about that! Maybe I have this characteristic, but I have never had a chance to think on it before.*"

Participant 13: "*There were characteristics, like being innovative and being creative, in other words, I thought that I didn't have enough of this characteristic in myself. For example, at the beginning of the semester, I was much too hesitant about finding about finding a project. So, how are we going to find one, how can we find one, everything seems to be found. But, I saw that one can be done if you think.*"

Participant 3: "*In order to be innovative, I saw that propounding new things or thinking about new things is not very much hard. Maybe we were not able to make a completely new thing, but I understood that we can make new things by making small changes.*"

The pre-service teachers previously stated that they had not been provided with opportunities to use their creativity that was based on entrepreneurial characteristics. It was also stated that the teachers began to carefully observe their surroundings after the education process. In contrast, when their views were investigated for the characteristic of **considering opportunities,** the following results were obtained.

Participant 12: "*I can be aware of considering the opportunities. I was insufficient in terms of considering the opportunities. I always aid if only. I don't recognize things on time. But I can consider the different aspects of an event now.*"

Participant 10: "*It could be considering the opportunities. Thus, there is a need to use opportunities. I used to use opportunities but I don't have a point of view. Behold, I knew, but I was not aware.*"

From these perspectives, it can be implied that the pre-service teachers were initially not open to seeing the opportunities that arose around them. However, after the education, the teachers understood the importance of considering the opportunities and learned that if they were provided an opportunity, they should seize it. Additionally, some of the pre-service teachers mentioned **self-confidence** as a part of entrepreneurship as in the following examples.

Participant 2: "*In addition to this, my self-courage apparently increased on these issues. Thus, I can say that I realized that I am a little bit productive on creative think-*

ing. With respect to my old self, I see that I think better. I reach the result better. I produce more innovative ideas."

Participant 8: "*Regarding self-confidence, I thought that I had self-confidence before, but I was not aware from which point I had self-confidence. Now, after investigating and participating a little bit more, we learned that we are more equipped when we look at how to make decisions by examining from different perspectives what kinds of results can emerge and what the benefits are.*"

Based on these perspectives, the teacher candidates indicated increases in their self-confidence after exposure to the entrepreneurship education. The teacher candidates previously thought that they lacked self-confidence because they had no experience or information about entrepreneurship education. Positive results were observed in the perspectives of the teacher candidates who were investigated after the entrepreneurship education in the dimension of **emotional intelligence,** which is comprised by the desire for success, self-motivation, driving emotions, decision making, and self-control. Examples are provided below.

Participant 14: "*For example, more than one thing was popping in my mind, like we can do this or that when we initially suggested doing something regarding whether there was a benefit in terms of emotional intelligence while evaluating the activities during this process. We studied together with my friend, and everything that I offered was not accepted or received criticism from different perspectives, such as, if we do this, then it happens like this, and if we do that, then it happens like that. Normally, that was not a characteristic of mine. I was like I said and this should be accepted. However, I broke my opinion. We tried another one if it was not working or we begin to consider different points of view.*"

Participant 3: *"Too much opportunity was provided to understand others, to explain myself, and to share ideas with others. I think that I defeated it."*

The teacher candidates with these types of views considered entrepreneurship education in terms of self-explanations, esteem regarding the emotions and ideas of others, and being open to positive and negative criticism. In the post-interviews, the teacher candidates described themselves more positively in terms of each of the entrepreneurial characteristics. Furthermore, they evaluated and provided more exploratory information about this education in terms of its efficacy and the types of characteristics.

Discussion and conclusion

Currently, it can be said some occupations are not sufficient to occupy people due to the rapid increase in the human population. Therefore, the acquisition of entrepreneurial characteristics is important to help people employ themselves. The acquisition of these characteristics, particularly in young students, can also be important for their futures. From this perspective, it can be said entrepreneurial characteristics can

be better developed in science education, which includes the introduction of different occupations and accounting for those occupations among the students' aims. For this process, the pre-service science teachers who are going to be the practitioners of the middle school science curriculum need to have information and experience regarding this issue. Thus, it has been stated that the teaching curriculums that have been used in science teacher education need to be reconstructed such that they equip teachers with information, skills, attitudes, and proficiencies regarding entrepreneurship (Achor & Wilfred-Bonse, 2013). Hence, there were no significant differences regarding self-confidence, while positive effects were observed in the quantitative findings related to risk taking, being innovative, emotional intelligence, and considering opportunities in the present research, which aimed to the develop entrepreneurial characteristics of science teacher candidates. The qualitative findings from the pre-interviews revealed that the teacher candidates were insufficiently able to evaluate themselves in terms of characteristics, information and experiences. In contrast, in the post-interviews, the teachers knew what the entrepreneurial characteristics were, and they came to a conclusion regarding the inclusion of entrepreneurial characteristics. Another finding obtained in this research that is related to the entrepreneurial characteristics is that the teacher candidates believed they had improved, as reported in the post-interviews. The obtained findings are separately considered in terms of entrepreneurial characteristics in the next paragraphs.

A study of entrepreneurs reported that low-level entrepreneurs have a tendency to take much greater risks (Cabar, 2006). In the science-art faculty out of finance department, the that undergraduate students who did not have entrepreneurship education were found to be timid and insufficiently able to build something new by assuming all risks and responsibilities, although they seemed to be eager to take risks and consider opportunities (İbicioğlu, Taş & Özmen, 2010). Thus, people with less knowledge and experience about entrepreneurship behave more bravely and have a tendency to unconsciously take risks. In contrast, people with knowledge and experience about entrepreneurship have a tendency to exhibit more stable and conscious risk taking. For example, college students who participate in entrepreneurship competitions are able to make plans for the future and have a tendency to take more risks (Demir, Tüfekci & Tüfekci, 2013). Similarly, in the present research, entrepreneurship education was also found to positively influence the risk-taking tendencies of teacher candidates as evidenced both in the scale data and interviews. Thus, it is clear that risk taking characteristics can be developed through formative assessment, which is frequently applied by educators teaching science (Bell & Cowie, 2001).

Science is known to be a school course in which different methods and techniques are frequently applied to teach abstract concepts. Thus, teachers who are going to instruct science courses should have great self-confidence in terms of professional proficiency. Similarly, it has been reported that teachers lack self-confidence in terms of teaching science (Appleton, 1995). Thus, research into the development of confi-

dence in science teachers is important. Moreover, teacher candidates who complete classical science courses have been reported to fail to develop self-confidence (Stepans & Mccormack, 1985), and the self-confidence provided by the entrepreneurship education curriculums positively affect students (Vinten & Alcock, 2004). However, in the present study, entrepreneurship education curriculum did not significantly affect the self-confidence of the pre-service science teachers, but this education exerted a clearly positive effect on self-confidence based on the interview data.

Pre-service science teachers who have been educated in education faculties do not have ideas about the focuses of different occupations or the development of their own work through innovative ideas because of their teacher educations. Therefore, in this education process, the teachers' innovative sides are not involved or developed. However, people's innovative sides derive from creativity and can be developed by the provision of different curriculums such as entrepreneurship education. College students who produce projects for entrepreneurship competitions like to work on innovative projects and are open to new ideas and applications rather than old applications (Demir, Tüfekci & Tüfekci, 2013). Thus, teachers also need to be entrepreneurs who exhibit innovative and creative sides to their teaching approaches that reflect both positive teaching and learning processes (Bakar et al., 2001). Thus, entrepreneurship education exerted a positive effect in terms of the innovative characteristics of the teacher candidates according to the findings obtained in this study. Similarly, Amos and Onifade (2013) stated that they believe in the necessity of entrepreneurship education for the development of the innovative characteristics of students in colleges of education. Beginning from this point, it can be said that teacher candidates with entrepreneurship education begin to perceive their environments differently and become aware to produce more innovative ideas.

It has been emphasized that good teachers primarily need to understand the emotions, ideas, and behaviors of their students to lead the students to construct positive social relations, actively participate and be willing to learn (Singh & Jha, 2012). The realization of process can be related to the emotional intelligence of the teachers. Goleman (2000) listed characteristics that a person with emotional intelligence should possess including self-awareness, self-control, social awareness, and social characteristics. The emotional intelligence levels of teachers need to meet a required level in science education at which the teaching and learning processes can be provided both in school and out of school in regard to those characteristics. To achieve this goal, educational implementations that seek to develop the emotional intelligence of teacher candidates are important in teacher education. However, it was shown that these characteristics of teachers cannot be developed in general. For example, Mortiboys (2005) mentioned that emotional intelligence is not considered among the characteristics that can be provided by a teacher who is ignorant of this dimension. According to the literature, the emotional intelligence of college students can specifically be developed through entrepreneurial activities. For example, it has been reported that students who participate

in entrepreneurship competitions in university exhibit better decision making and more creative alternative choices based their self-confidence if a conclusion is reached (Demir, Tüfekci & Tüfekci, 2013). These findings have attracted attention to innovative projects produced by college students who want to participate in different projects without hesitation and doe not relate their decisions to outside effects (Demir, Tüfekci & Tüfekci, 2013). Thus, the implementation of entrepreneurship education positively affected the emotional intelligence characteristics both in terms of the statistical data and the interviews in the present research.

It has been stated that a person with an entrepreneurial mentality who tends to rapidly comprehend the situation and take action (Ireland, Hitt & Sirmon, 2003) also tends to hold onto opportunities (Teerijoki & Murdock, 2014). Similarly, teacher candidates can be provided opportunities to make more careful observations and ideas about their occupation through the development of an entrepreneurial mentality in those who only think about the teaching profession. Teachers have an important responsibility to enable students to capitalize on occupational opportunities in addition to the primary aims of science education, i.e., providing knowledge and experience about professions related to science and technology to the students. Therefore, the provision of entrepreneurial education to teacher candidates is highly important in terms of enabling them to consider the opportunities. For example, college students who have never had entrepreneurial education have been reported to be reluctant and noncommittal regarding the formation of new things, taking responsibility, and taking risks even if they seem to be eager to take risks regarding opportunities that are out of their finance in science-art faculties (İbicioğlu, Taş & Özmen, 2010). Thus, teacher candidates can be enabled to make more careful observations through entrepreneurship education. This research indicates that the characteristic of capitalizing on opportunities among teacher candidates can be increased with entrepreneurship education. The candidates stated that their perspectives changed relative to their conditions before the curriculum in terms of considering opportunities as reflected in the qualitative data. Depending on the views of the candidates, a meaningful difference between the pre- and post-test scores was observed in the quantitative data.

Consequently, we conclude that entrepreneurship education positively affected the pre-service science teachers' entrepreneurial characteristics both in terms of the statistical data and the interviews. The pre-service science teachers who declared their lack of knowledge and experience in entrepreneurial concepts in the pre-interviews stated that entrepreneurship education should be provided for all pre-service teachers during the interviews that were conducted after the education process. In terms of the entrepreneurial characteristics, the pre-service teachers were able to evaluate themselves after the implementation, while they found it difficult to describe entrepreneurial characteristics before the implementation. Moreover, it is notable that the teachers were able to make evaluations related to what types of characteristics they did or did not possess. Similarly, in-service science teachers are not able to know

exactly what types of characteristics entrepreneurial persons should have, even after undergraduate education on this issue (Bacanak, 2013). Thus, the implementations of curriculums prior to service can be more important for improving the entrepreneurial characteristics of pre-service science teachers. In contrast, there are studies that propound the notion that teachers are able to possess entrepreneurial characteristics and that these characteristics can be improved via in-service education curriculums (Bakar, Pihie, Akmaliah, Konting & Angking, 2001).

Due to the entrepreneurship education provided in this study, the pre-service teachers stated that they were not hesitant to produce new ideas, to believe in themselves or to take risks when necessary; they also improved in terms of confidence about producing innovative things. Moreover, we have observed that they felt positive changes in themselves regarding the acceptance of negative critics, respecting the views of others, understanding others and exhibiting a greater tendency to capitalize on opportunities that are waiting to be explored. This research demonstrated that pre-service teachers can make entrepreneurial project proposals. This is a very encouraging result particularly in light of the fact that some of the college students did not entrepreneurial work outside of their occupation as positive. For example, senior students from the college of science-art have stated that at the beginning of their professional lives education is more important than saving money (İbicioğlu, Taş & Özmen, 2010). Nevertheless, the senior students with finance educations were eager to make money and build their careers (İbicioğlu, Taş & Özmen, 2010). Similarly, students who participate in entrepreneurship competitions exhibit positive readiness towards entrepreneurial culture (Demir, Tüfekci & Tüfekci, 2013). Moreover, Bacanak (2013) stated that entrepreneurial characteristics should be included among the occupational characteristics of science teachers. Similarly, students have stated that entrepreneurship education is important and necessary in teacher education curriculums (Amos & Onifade, 2013). Finally, entrepreneurship education exerts positive effects on the entrepreneurial characteristics of pre-service science teachers.

Based on the results of this research, entrepreneurship education can be provided at least as a selective course for undergraduate pre-service science teachers. Entrepreneurial characteristics are thought to be acquired through entrepreneurship education and can potentially be acquired through similar curriculums. In-service education courses, such as seminars, can be organized for the science teachers who are in service and have not had entrepreneurship education. The extent to which this knowledge and experience can be utilized can be determined by the qualitative methods adopted by researchers during their professional lives and applied to the screening of entrepreneurship education courses provided for pre-service science teachers.

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References

A guide to Enterprise Education. (2009). *A guide to enterprise education. for enterprise coordinators, teachers and leaders at schools*. Commissioned by DCSF and carried out by Dubit between September 2009 and February 2010 in collaboration with Bright purpose and the Young People's Enterprise Forum (YPEF).

Achor, E.E., & Wilfred-Bonse, K.U. (2013). The need to integrate entrepreneurship education into science education teachers' curriculum in Nigeria. *Journal of Science and Vocational Education*, *7*, 111-123.

Adeyemo, S.A. (2009). Understanding and acquisition of entrepreneurial skills: a pedagogical reorientation for classroom teacher in science education, *Journal of Turkish Science Education*, *6* (3), 57-65.

Amos, A., & Onifade, C.A. (2013). The perception of students on the need for entrepreneurship education in teacher education programme. *Global Journal of Human-Social Science Research*, *13* (3), 75-80.

Antonites, A.J., & Van-Vuuren, J.J. (2005). Inducing entrepreneurial creativity, innovation and opportunity-finding skills: management. *South African Journal of Economic and Management Sciences*, *8* (3), 255-271.

Appleton, K. (1995). Student teachers' confidence to teach science: is more science knowledge necessary to improve self confidence? *International Journal of Science Education*, *17* (3), 357-369.

Ary, D., Jacobs, L.C., Sorensen C., & Razavieh, A. (2010). *Introduction to research in education*, 8th Edition, Wadsworth: Cengage Learning, Belmont.

Bacanak, A. (2013). Teachers' views about science and technology lesson effects on the development of students' entrepreneurship skills. *Educational Sciences: Theory & Practice*, *13* (1), 622-629.

Bakan, İ., Eyitmiş, A.M., Büyükbeşe, T., & Erşahan, B. (2012). Kahramanmaraş'ta girişimcilik ve yenilikçilik: Profesyonel meslek gruplarında bir alan çalışması. *II. Bölgesel Sorunlar Ve Türkiye Sempozyumu*, 1-2 Ekim 2012. Kahramanmaraş.

Bakar, A., Pihie, L., Akmaliah, Z., Konting, M.M., & Angking, G.K. (2001). The perceived entrepreneurial characteristics of Malaysian living skill teachers: implication for teacher preparation programme. *Pertanika Journal of Social Sciences & Humanities*, *9* (2), 123-129.

Baranović, B., Stibric, M., & Domovic, V. (2007). Enterprise education – the perspective of teachers in compulsory schools. sociology and space. *Journal for Spatial and Socio-Cultural Development Studies*, *45* (3–4), 339-360.

Beca, J. (2007). *The Need For Improvement ın Innovativeness Development And Entrepreneurship Training in High school And University Science Education*. T-Space at The University of Toronto Libraries, University of Toronto Mississauga. Retrieved from http://hdl.handle.net/1807/10112 at 08.04.2013

Bell, B., & Cowie, B. (2001). The characteristics of formative assessment in science education. *Science education*, *85* (5), 536-553.

Bikse, V. (2009). *Petijums Latvijas progress uznemejdarbibas izglitibas attistiba pec iestajas Eiropas Savieniba / Research, The progress of the development of en-*

trepreneurship education in Latvia after joining the European Union. Riga: University of Latvia, Faculty of Economics and Management, Mission of the European Commission in Latvia.

Birdthistle, N., Hynes, B., & Fleming, P. (2007). Enterprise education programmes in secondary schools in ireland: a multi-stakeholder perspective. *Education Training*, *49* (4), 265-76.

Bolaji, O.A. (2012). Intergrating enterpreneurship education into science education: Science teachers perspectives. *Journal of Science, Technology, Mathematics and Education, 8* (3), 181-187.

Boyatzis, R., Goleman, D., & Rhee, K. (2000). *Clustering competence in emotional intelligence. Insights from the emotional competence inventory* (ECI). In R. Bar-On & J. D. A. Parker (Eds.), Handbook of emotional intelligence (pp.343-367). San Francisco: Jossey-Bass.

Braun, G. (2008). *Evaluating international entrepreneurship education programmes: lessons from experience*. In *evaluating, experiencing and creating entrepreneurial and enterprising networks*, eds. G. Braun, P. Kyrö & S. Speer, 93–112. Tepere.

Buang, N. A., & Halim, L. (2007). U. K. Development of entrepreneurıal science thinking model for Malaysian, science and technology education. Retrieve from http://www.ukm.my/p3k/images/sppb07/29.pdf at 02.12.2014

Buang, N.A., Halim, L., & Meerah, T.S.M. (2009). Understanding the thinking of scientists entrepreneurs: Implications for science education in Malaysia. *Journal of Turkish Science Education*, *6* (2), 3-11.

Cabar, H. (2006). Türkiye'de girişimcilik kültürünün oluşmasında etkili faktörler ve Denizli örneği. Master Thesis, Institute of Social Sciences, University of Dumlupınar. Kütahya, Turkey.

Campbell, D.T., & Stanley, J.C. (1963). *Experımental and quası-experımental designs for research*. Houghton Mifflin Company, Printed in U.S.A. Library of Congress Catalogue Card Number 81-80806.

Carolyn, B. (2000). *Entrepreneurial education teaching guide. Kaufman center for entrepreneurial clearing house on entrepreneurship education*. Kansas City Digest. Adjunct ERIC clearing house on entrepreneurship education, Los Angeles, CA. (ERİC-ED 452 430).

Clayton, C.D. (2007). Curriculum making as novice professional development practical risk taking as learning in high-stakes times. *Journal of Teacher Education*, *58* (3), 216-230.

Connolly, P. (2007). *Quantitative data analysis in education, a critical introduction using SPSS*. USA and Canada: This edition published in the Taylor & Francis e-Library, ISBN 0-203-94698-7 Master e-book ISBN.

Corbett, A.C., & Hmieleski, K.M. (2005). How corporate entrepreneurs think: cognition, context, and entrepreneurial scripts. *Academy of Management Best Conference Paper*, D1-D7.

Cresswell, J. W. (2008). *Educational research*. New Jersey: Pearson Education Inc.

Cresswell, J. W. (2009). *Research design qualitative, quantitative, and mixed methods approaches*, 3th Edition. California: Thousand Oaks.

Creswell, J.W., & Plano Clark, V.L.P. (2011). *Designing and conducting mixed methods research*. Thousand Oaks, CA: Sage.

Deakins, D., Glancey, K., Menter, I., & Wyper, J. (2005). Enterprise education: the role of the head teacher. *International Entrepreneurship and Management Journal*, *1* (2), 241-63.

Demir, Y., Tüfekci, Ö.K., & Tüfekci, N. (2013). Üniversitelerdeki girişimcilik yarışmalarının girişimcilik kültürüne etkisi: Süleyman Demirel Üniversitesi'nde bir araştırma, *V Internatıonal Congress On Entrepreneurship*, Almatı.

Deveci, İ., & Çepni, S. (2014). Entrepreneurship in science teacher education. *Journal of Turkish Science Education*, 11(2), 161-188.

Deveci, İ., & Çepni, S. (2015). Development of Entrepreneurship Scale Towards Student Teachers: A validity and reliability study. *International Journal of Human Sciences*, *12* (2), 92-112.

Dolgun, U. (2003). *Girişimcilik*, Alfa Basım Dağıtım, İstanbul.

European Commission, (2008). *Entrepreneurship in higher education. Especially within non-business studies: Final report of the expert group*. Brussels, Belgium.

European Commission, (2009). *Entrepreneurship in vocational education and training final report of the expert group. enterprıse and industry dırectorate-general. promotion of SME competitiveness*. Directorate-General for Enterprise and Industry. Cover pictures © Fotolia.

European Commission, (2011). *Entrepreneurship education: enabling teachers as a critical success factor. A report on teacher education and training to prepare teachers for the challenge of entrepreneurship education*. Published by: Entrepreneurship Unit Bruxelles.

European Commission, (2012). *Guidebook series how to support SME policy from structural funds. building entrepreneurial mindsets and skills in the EU*. Directorate-General for Enterprise and Industry, ISBN 978-92-79-25878-7, doi:10.2769/40659. Luxembourg, Office for Official Publications of the European Union.

European Commission, (2013). *Entrepreneurship education, a guide for educators*. European Union Entrepreneurship and Social Economy Unit B-1049 Brussels.

European Commission, (2015). *Science education for responsible citizenship. Report to the european commıssıon of the expert group on scıence education*. Luxembourg: Publications Office of the European Union. doi: 10.2777/12626

Ezeudu, F.O., Ofoegbu, T.O., & Anyaegbunnam, N.J. (2013). Restructuring STM (science, technology, and mathematics) education for entrepreneurship. *US-China Education Review A*, *3* (1), 27-32.

Fiet, J.O. (2000a). The theoretical side of teaching entrepreneurship. *Journal of Business Venturing*, *16* (1), 1-24.

Fiet, J.O. (2000b). The pedagogical side of entrepreneurship theory. *Journal of Business Venturing*, *16* (1), 101-17.

Gibb, A. (2005). *The future of entrepreneurship education – determining the basis for coherent policy and practice*? In Kyro, P. and Carrier, C. (Eds), In The Dynamics of Learning Entrepreneurship in a Cross-Cultural University Context, University of Tampere, Research Centre for Vocational and Professional Education, Entrepreneurship Education Series, Ha¨meenlinna, pp. 44-67.

Gibb, A. (2011). Concepts into practice: meeting the challenge of development of entrepreneurship educators around

innovative paradigm. *International Journal of Entrepreneurial Behaviour & Research*, *17* (2), 146-65.

Gibb, A.A. (1993). The enterprise culture and education: understanding enterprise education and its links with small business. *International Small Business Journal*, *11* (3), 11–34.

Goleman, D. (2000). Leadership that gets results. *Harvard business review*, *78* (2), 78-93.

Goleman, D. (2011). *Duygusal zeka neden IQ'dan daha önemlidir*? 34. Basım. Varlık Yayınları, İstanbul.

Hannon, P.D. (2006). Teaching pigeons to dance: sense and meaning in entrepreneurship education. *Education and Training*, *48* (5), 296–308.

Heigham, J., & Croker, R. A. (Eds.). (2009). *Qualitative research in applied linguistics: a practical introduction*. Palgrave: MacMillan.

Heinonen, J. (2007). An entrepreneurial-directed approach to teaching corporate entrepreneurship at university level. *Education and Training*, *49* (4), 310–324.

Heinonen, J., & Poikkijoki, S. (2006). An entrepreneurial-directed approach to entrepreneurship education: Mission impossible? *Journal of Management Development*, *25* (1), 80–94.

Hisrich, R.D., Michael P., & Dean A.S. (2005). *Entrepreneurship*, 6th Edition, New York: McGraw-Hill.

İbicioğlu, H., Taş, S., & Özmen, İ. (2010). Effect of the concept of entrepreneurship on university education; A study on university students. *Journal of Alanya Faculty of Business*, *2* (1), 53-74.

Ireland, R.D., Hitt, M.A., & Sirmon, D.G. (2003). A model of strategic entrepreneurship: the construct and its dimensions. *Journal of Management, 29* (6), 963-989.

Johannisson, B. (2002). Enacting entrepreneurship–using auto-ethnography to study organization creation. Paper Presented *the Conference Ethnographic Organizational Studies*, University of St. Gallen, Switzerland, September 19–21.

Jones, C. (2006). Constructive alignment: a journey for new eyes. *Journal of Enterprising Culture*, *14* (4), 291–306.

Jones, C. (2007). Enterprise education: the frustration of a pure contest. *Education Training*, *49* (8/9), 596-604.

Karakuş, U. (2007). Experiments method and its usage in geographic teaching. *Journal of Kırşehir Education Faculty, 8* (1), 1-19.

Koh, H.C. (1996). Testing hypotheses of entrepreneurial characteristics: A study of Hong Kong MBA students. *Journal of Managerial Psychology*, *11* (3), 12-25.

Löbler, H. (2006). Learning entrepreneurship from a constructivist perspective. *Technology, Analysis & Strategic Management*, *18* (1), 19–38.

Macko, A., & Tyszka, T. (2009). Entrepreneurship and risk taking. *Applied Psychology*, *58* (3), 469-487.

Ministry of Education, (2013). *Primary schools (primary and secondary schools), science course (3, 4, 5, 6, 7 and 8. grades), Curriculum*, Ankara, Turkey.

Ministry of Education, (2013). *Primary schools (primary and secondary schools), science course (3, 4, 5, 6, 7 and 8. grades), Curriculum*, Ankara, Turkey.

Ministry of Education, (2017). *Primary schools (primary and secondary schools), science course (3, 4, 5, 6, 7 and 8. grades), Curriculum*, Ankara, Turkey.

Mortiboys, A. (2005). *Teaching with emotional intelligence: A step-by-step guide*

for higher and further education professionals. New York: Routledge.

Napier, A.H., Rivers, O.N., Wagner, S.W., & Napier, J.B. (2006). *Creating a wining e business*. 2th edition, U.S: Thomson Course Technology.

National Association for the Self-Employed, (2004). Statistics: America's Young Entrepreneurs. Retrieved from http://www.nase.org/fey/youngentrepreneurs_stats.htm# index. at 02.03.2013

Neck, H.M., & Greene, P.G. (2011). Entrepreneurship education: known worlds and new frontiers. *Journal of Small Business Management*, *49* (1), 55-70.

Ng, P.T. (2007). Quality assurance in Singapore education system in an era of diversity and innovation. *Educational Research for Policy and Practice*, *6* (3), 235–247.

Ng, P.T. (2010). The evolution and nature of school accountability in the Singapore education system. *Educational Assessment, Evaluation and Accountability*, *22* (4), 275–292.

Oganisjana, K. (2006). *Entrepreneurship or enterprising through schooling*. In A. Kruze, I. Mortag & D. Schulz (Eds.) Globalisierung der wirtschaft-internationalisierung der lehrerbildung 3 (45-61). Leipzig: Leipziger Universitatsverlag.

Palmer, P.J. (2003). Teaching with heart and soul reflections on spirituality in teacher education. *Journal of Teacher Education*, *54* (5), 376-385.

Palomera, R., Fernandez-Berrocal, P., & Brackett, M. A. (2008). La inteligencia emocionalcomo una competencia basica en la formacion inicial de los docentes: algunas evidencias [emotional intelligence as a basic competency in initial training for teachers: some evidence]. *Revista Electronica de Investigacion Psicoeducativa*, *15* (6-2), 437-454.

Rae, D. & Carswell, M. (2001). Toward a conceptual understanding of entrepreneurial learning. *Journal of Small Business and Enterprise Development*, *8* (2), 150-8.

Raffo, C., Lovatt, A., Banks, M., & O'Connor, J. (2000). Teaching and learning entrepreneurship for micro and small businesses in the cultural industries sector, *Education + Training*, *42* (6), 356-365.

Rasmussen, E. & Sørheim, R. (2005). Action-Based Entrepreneurship Education. *Technovation*, *26* (2), 185-194.

San-Tan, S., & Ng, C. F. (2006). A problem-based learning approach to entrepreneurship education. *Education + Training*, *48* (6), 416-428.

Seikkula-Leino, J. (2008). *Advancing entrepreneurship education in the Finnish basic education – the prospect of developing local curricula*, in Fayolle, A. and Kyro, P. (Eds), The Dynamics between Entrepreneurship, Environment and Education, Edward Elgar, Cheltenham, pp. 168-90

Seikkula-Leino, J. (2011). The implementation of entrepreneurship education through curriculum reform in finnish comprehensive schools. *Journal of Curriculum Studies*, *43* (1), 69-85.

Seikkula-Leino, J., Ruskovaara, E., Ika¨valko, M., Mattila, J., & Rytko'la, T. (2010). Promoting entrepreneurship education: The role of the teacher? *Education Training*, *52* (2), 117-27.

Shane, S., & Venkatamaran, S. (2000). The promise of entrepreneurship as a field of research. *The Academy of Management Review, 25* (1), 217–226.

Shulman, L. S., & Tamir, P. (1973). *Research on teaching in the natural sciences*. In R. M. W. Traver (Ed.), Second Handbook of Research on Teaching (pp. 1098–1148). Chicago: Rand McNally.

Singh, I., & Jha, A. (2012). Teacher effectiveness in relation to emotional intelligence among medical and engineering faculty members. *Europe's Journal of Psychology, 8* (4), 667-685.

Solomon, G. (2007). An examination of entrepreneurship education in the United States. *Journal of Small Business and Enterprise Development*. *14* (2), 168-82.

Soutaris, V., Zerbinati, S., & Al-Lahan, A., (2007). Do entrepreneurship programs raise entrepreneurial intention of science and engineering students? The effect of learning, inspiration and resources. *Journal of Business Venturing*, *22*, 566-591.

Stepans, J., & Mccormack, A. (1985). A study of scientific conceptions and attitudes toward science of prospective elementary teachers: A research report. Paper presented at the meeting of *the Northern Rocky Mountain Educational Research Association*, Jackson Hole, WY, October.

Teerijoki, H., & Murdock, K.A. (2014). Assessing the role of the teacher in introducing entrepreneurial education in engineering and science courses. *The International Journal of Management Education*. *12* (3), 479–489.

Ulaş, D. (2006). The evaluation of franchising system in turn of its entrepreneurial capacity. *Gazi Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *8* (3), 1-19.

Vinten, G., & Alcock, S. (2004). Entrepreneuring in education. *International Journal of Educational. Management*, *18* (3), 188-195.

Willig, C. (2008). *Introducing qualitative research in psychology adventures ın theory and method*, 2th Edition. England: Open University Press, McGraw-Hill Education.

Wing Yan Man, T. (2006). Exploring the behavioural patterns of entrepreneurial learning. a competency approach. *Education and Training*, *48* (5), 309–321.

Yavari, F., Heydarinejad, S., & Habibi, A. (2013). Study of entrepreneurship characteristics among physical education students and effect of university's courses on its development. *International Journal of Sport Studies*, *3* (1), 67-73.

Zakarevičius, P., & Župerka, A. (2010). Expression of emotional intelligence in development of students' entrepreneurship. *Economics and Management*, *15*, 865-873.

Zhao, H., Seibert S.E., & Hills, G.E. (2005). The mediating role of self efficacy in the development of entrepreneurial intentions. *Journal of Applied Psychology*, *90* (6), 1265-1272.

Į GAMTOS MOKSLŲ MOKYMĄ INTEGRUOTŲ VERSLUMO UGDYMO MODULIŲ POVEIKIS BŪSIMŲ GAMTOS MOKSLŲ MOKYTOJŲ VERSLUMO SAVYBĖMS

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Santrauka

Verslumo savybės yra vienos svarbiausių savybių, kurias gali įgyti studentai XXI amžiuje. Iki 2012 m. Turkijoje nebuvo jokių duomenų apie gamtos mokslų mokymo programų verslumo ugdymo metodų tyrimus pirminėje švietimo pakopoje. Tačiau pastaraisiais metais verslumo ugdymo srityje mūsų šalyje ir kitose šalyse (pvz., Suomijoje, Malaizijoje, Nigerijoje) buvo imtasi konkrečių žingsnių.

Šio tyrimo tikslas buvo ištirti į gamtos mokslų mokymą integruotų verslumo ugdymo modulių poveikį būsimų gamtos mokslų mokytojų verslumo savybėms (polinkiui prisiimti riziką, gebėjimui įžvelgti galimybes, inovatyvumui, pasitikėjimui savimi ir emociniam intelektui).

Tyrimas buvo vykdomas 2013–2014 mokslo metais pasirinkto kurso metu, jame dalyvavo 26 būsimi gamtos mokslų mokytojai, studijuojantys trečiame kurse Turkijoje. Tyrimui buvo pritaikytas mišraus modelio metodas. Kokybinė tyrimo dimensija apėmė fenomenologinę analizę, o kiekybinėje dimensijoje buvo pritaikytas paprastas eksperimentinis metodas. Duomenys buvo gauti naudojant „verslumo skalę" ir atliekant pusiau struktūruotus interviu. Interviu būdu gauti duomenys pateikiami naudojant aprašomąją analizę. Tuo tarpu prieš ir po eksperimentinio tyrimo gautiems duomenims buvo pritaikytas Vilkoksono ženklų kriterijus (angl. Wilcoxon Signed Rank Test).

Tyrimo rezultatai parodė, kad verslumo ugdymas turėjo statistiškai reikšmingą teigiamą poveikį būsimų gamtos mokslų mokytojų polinkiui prisiimti riziką, gebėjimui įžvelgti galimybes, inovatyvumui ir emociniam intelektui. Tuo pačiu kokybiniais metodais buvo nustatyta, kad toks ugdymas yra teigiamai vertinamas. Tačiau nebuvo jokio reikšmingo pasitikėjimo savimi savybių pokyčio.

Remiantis šio tyrimo rezultatais, verslumo ugdymą galima būtų pateikti būsimiems gamtos mokslų mokytojams bent jau kaip pasirenkamąjį kursą. Manoma, kad verslumo ugdymas padeda įgauti verslumo savybių, tad jų įgauti galimai padeda ir atitinkami kursai. Esamiems gamtos mokslų mokytojams, kurie jau dirba mokytojais ir neturėjo verslumo ugdymo, galima organizuoti dirbančiųjų ugdymo kursus, pvz., seminarus.

Reikšminiai žodžiai: verslumas, mokytojų mokymas, gamtos mokslų mokymas

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