The Effect of Common Knowledge Construction Model Based Science Education on Entrepreneurship Skills of Secondary School Students

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Abstract

This research aims to investigate the impact of Common Knowledge Construction Model (CKCM) based science education teaching on the entrepreneurship skills of the eight grade students. The participants of this research are 50 students; 25 in control group (10 girls and 15 boys) and 25 in experimental group (9 girls and 16 boys). Quasi-experimental method was employed in the study. Entrepreneurship Scale and Semi-structured entrepreneurship interview forms were used. While the data of the Entrepreneurship Scale were analysed using dependent and independent t-test, the semi-structured Interview were analysed by content and descriptive analysis. The findings showed that current teaching process applied in CKCM-based science teaching and control group (5Es learning model) was effective on entrepreneurial skills of secondary school students. When the experimental and control groups were compared, it was found out that in the experimental group, science teaching based on CKCM was more effective on the entrepreneurial skills of students as opposed to the 5Es learning model-based science teaching used with the control group students. The effect of CKCM on entrepreneurship skills could be more clearly identified if more research is taken with different levels of teaching.

Keywords: Science Teaching, Common Knowledge Construction Model, Entrepreneurship, Eighth Grade Students.

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INTRODUCTION

Entrepreneurship skills introduced under the life skills are one of the recently introduced innovations in the Science Curriculum. The aim of this practice is to enable students to grow as entrepreneurial individuals. Entrepreneurship is defined as a step taken to realize people's dreams. In entrepreneurship, students are expected to take risks, act and produce. Production plays an important role to address student's sense of curiosity which in return increases self-esteem (Deveci, 2016; Özdemir, 2016). In the Science Curriculum, entrepreneurial skills are defined as forming relationships, planning what they should be doing and are going to do, taking risks, implementing their plans and making beginnings to achieve their goals (Ministry of National Education [MEB], 2013). As a matter of fact, this includes skills such as organizing various socio-cultural activities with individual or groups (such as competition, play, and picnic), persuasion and self-confidence. The most distinctive features that distinguish entrepreneurial individuals from others are being creative and innovative, producing new ideas and putting these ideas into practice (Amos & Onifade, 2013).

One of the important points in the Science Curriculum is to equip students with entrepreneurial skill. This is an important life skill. It has great importance in the development of qualified individuals. Compared to the previous centuries, entrepreneurial skills have become a necessity for individuals to acquire different skills in the 21st century. Individuals are asked not only to learn and use information, but to make information available for people, to analyse it from different perspectives, to have different interpretations and to make personal designs and inventions. It is thought that all these expectations can be gained more easily by providing entrepreneurship skills in schools. In many developed countries, the student is required to actively produce a product and to present it effectively. The main aim is to combine knowledge learned in the school with real life knowledge and to use it in daily life (Antonites & Van-Vuuren 2005; Bikse, 2009; Heinonen & Poikkijoki, 2006; Heinonen, 2007; Jones, 2006; Oganisjana, 2006). Therefore, entrepreneurship is seen as a career option (Deveci, 2016). In this context, the Science Curriculum prepares students for future and fulfils their duty in terms of entrepreneurship education (Beca, 2007). In addition, the basic entrepreneurship education overlaps with science education because they aim to gain similar skills to students (Deveci & Seikkula-Leino, 2018).

In recent years, one of the teaching models used in science teaching is the Common Knowledge Construction Model (CKCM). CKCM was first developed by Ebenezer and Connor in 1998. In terms of its theoretical roots, the model is based on Marton's Variation Theory of Learning and Piaget's conceptual change research (Ebenezer, Chacko, Kaya, Koya & Ebenezer, 2010). In addition, this model also draws from Bruner's philosophy that considers language as a part of culture's symbolic system, Vygotsky's zone of proximal development and Doll's ideas on science discourse and postmodern ideas on curriculum (Biernacka, 2006). The CKCM has four basic phases: Exploring and Categorizing, Constructing and Negotiating, Translating and Extending, and Reflecting and Assessing. CKCM focuses on the nature of science, socio-scientific issues, critical thinking and entrepreneurship skills (Bakırcı, Çalık & Çepni, 2017). The teaching activities in the second and third stages of the teaching model focus on the development of the entrepreneurial skills of the students.

During exploring and categorising session, activities such as scientific discourse under the supervision of teachers, inter-group discussions, and student participation are carried out (Duschl & Osborne, 2002). The main aim here is to help students understand each other's ideas, express their opinions and gain social skills such as empathy. This situation contributes to the development of entrepreneurial skills of students directly (Bakırcı & Ensari, 2018). In the third stage of CKCM, different teaching techniques are applied to help students explain their thoughts about socio-scientific issues. In addition, students are expected to find solutions to social and environmental problems in a national and international context and to participate in discussions on the nature of science. In addressing these issues, students need to consider the interaction between science, technology, society and the environment. The aim of these teaching activities in the second and third stages of the model is to develop students' entrepreneurship and critical thinking skills (Biernacka, 2006; Ebenezer & Connor, 1998).

It can be said that some of the learning support materials used in CKCM based learning environment influence students' entrepreneurship skills. Worksheet, analogies, conceptual change texts and concept cartoons can be given as examples because these teaching materials are found to be effective in providing concepts such as sharing, friendship, and dealing with friends, cooperation, leadership and honesty. (Bakırcı & Ensari, 2018). Besides the economic functioning of enterprises, entrepreneurship education aims to teach planning, negotiation, organization, communication, working with individual or group, analysis, opportunities for personal or professional business activities, risk taking. In addition to these characteristics, it aims to give the students the consciousness of self-motivation (Curth, 2011). Students can gain entrepreneurial features through science laboratory applications, in-class and extracurricular activities (Adeyemo, 2009). In CKCM based learning environments, the use of different teaching materials and laboratory-assisted teaching approaches, discussions and student-centred activities contribute to the development of students' entrepreneurial skills (Çalık & Cobern, 2017).

There are many studies on entrepreneurship in literature. These studies were mostly carried out in the fields of industry, economy and business. However, they emphasize limited work of entrepreneurship in the field of education (Bakırcı & Öçsoy, 2017; Deveci, 2018). In the literature, the studies on education have been carried out with students studying at different levels of education. Especially, studies conducted with university students were found to be more than other levels (Deveci, 2016). In education literature, research mostly focused on entrepreneurship skills, the effects of various courses and activities on entrepreneurship skills, the comparison of entrepreneurship tendencies of students in different departments and universities, and entrepreneurs, teachers, students' opinions on entrepreneurship (Akkuş & Menteş, 2017; Çetin, 2015; Temizkan, 2014). Nevertheless, it can be said that there is not enough research in literature related to CKCM. On the other hand, it has been determined that the studies conducted with secondary school students on entrepreneurship are limited (Bakırcı & Öçsoy, 2017).

The results of the research in the field of entrepreneurship are positive. For instance, students with kinaesthetic learning style has better entrepreneurial skills and this is followed by those who have visual learning styles (Çetin, 2015). Additionally, in terms of students' opinion on entrepreneurship, they stated that those who fail in their own business should have another chance. In another study, it was found that the students believe in securing their future through establishing their own business (Altıntop, 2015). Entrepreneurship, which is among the life skills of the current century, is included in the Science Teaching Curriculum in 2018. This reveals importance of these skills because, it is thought that an individual, who has entrepreneurship skills, will adapt better to society in the future and s/he will overcome problems in daily life more easily. From this point of view, this research is important in terms of understanding the effect of CKCM on students' entrepreneurial skills.

When the literature is examined, it was seen that the entrepreneurship course given at universities changes the perception of problem solving in daily life and provides an increase in the orientation towards entrepreneurship. Besides, it was seen that entrepreneurial individuals adapt more quickly to daily life (Beca, 2007; Bikse, 2009; Weber, 2011). Many studies show that primary school (primary and secondary school) years are important in gaining entrepreneurship skills (Deveci & Seikkula-Leino, 2018). One of the characteristics sought in qualified individuals is entrepreneurship. Teaching models and approaches have great importance in the training of entrepreneurial individuals. Therefore, this study was carried out with secondary school students. The main purpose of using CKCM is that this model is a teaching model aiming to provide students with entrepreneurial skills (Bakırcı, Çalık & Çepni, 2017). It can be said that the discussions following the experiments and activities in the second stage of the CKCM and the collaborative activities in the third stage of the model will have an impact on the entrepreneurial skills of the students. In the literature reviews, there exist no study to investigate the effect of CKCM science teaching - based on entrepreneurial skills. In this respect, it is thought that this study will contribute to the literature. In addition, it is considered that the CKCM could be an alternative teaching model for teachers who will provide entrepreneurship skills to students. This research aims to investigate the effect of CKCM based science teaching on the

entrepreneurial skills of eighth grade students. For this purpose, the following research questions were sought:

What is the effect of science teaching based on the CKCM on entrepreneurial skills of eighth grade students in the experimental group?

What is the effect of science teaching based on 5Es learning model on entrepreneurial skills of eighth grade students in the control group?

Has there been any change in the entrepreneurial skill levels of eighth grade students in science teaching in the experimental and control groups after the implementation?

METHOD

Research Design

The aim of this study was to determine the effect of science teaching based on the Common Knowledge Construction Model on the entrepreneurship skills of eighth grade students. This research method is called the research design in which randomly assigned assignments are made to the groups to which the application will be made when the experimental design is not applied in educational research (Çepni, 2011). Since the measurements of the experimental and control groups of different subjects are compared, it is known as an unrelated pattern. They are defined as related patterns since they are measured in relation to the dependent variable before and after the experimental procedure (Karasar, 2017). In order to find answers to the research questions, entrepreneurship scale was applied as pre-test and post-test and semi-structured interview was applied as post-test. The experimental design of the research is given in Table 1.

Table 1. Experimental Design of Research

Groups	Pre-test	Process	Post-test
Experimental	Entrepreneurship Scale	In the experimental group, the courses were processed according to the Common Knowledge Construction Model. The study material was developed by researchers.	Entrepreneurship Scale Semi-structured Entrepreneurship Interview Form
Control	Entrepreneurship Scale	The courses were taught according to 5Es learning model. The related activities in the courses are taken from the 8th grade Science Textbook proposed by the Ministry of National Education.	Entrepreneurship Scale Semi-structured Entrepreneurship Interview Form

Study Group

The sample of the study consists of 50 students (25 members for the study group and 25 for the controls) studying in the eighth grade of a secondary school in a province in Eastern Anatolia in the 2017-2018 academic year. The participants of this research are 50 students (25 experiment group and 25 control group) in the eighth grade of a secondary school in the centre of the town of Tusba, Van during 2017-2018 academic year. The experimental group consisted of 10 female and 15 male students; the control group consisted of 9 female and 16 male students. The participants were randomly assigned to experimental and control groups. There are three classes of eight grade in the school: 8/A, 8/B and 8/C. After applying the entrepreneurship scale to these three classes, the participants were identified by taking the results from these scales into consideration. According to the results of this scale, 8/A and 8/B classes showed to have similar level of knowledge whereas the knowledge of entrepreneurship of 8 /C was different than the other two classes. Therefore, 8/C was not included in the research. It was decided that 8/A would be the experimental group and 8/B branch would be the control group. While the students to be interviewed were selected, 7th grade of science

courses of students were ranked from the lowest to the highest. The mean scores were divided into three equal parts and two students were randomly selected from each level and in total 6 students were interviewed. Semi-structured interviews lasted approximately 25-30 minutes. Interviews were held in the classroom reserved for the Science course. According to the ethics of the research, the students in the experimental group were coded as $D_1, D_2, D_3, ………D_{25}$, and the control group students as $K_1, K_2, K_3,…………….K_{25}$.

Implementation

The course lasted around six weeks in the experimental and control groups. The courses in the control group were based on the current teaching model. The researcher worked with the materials that align with the CKCM's teaching method for the experimental group. The plan and materials employed in current teaching method were used with the control group were used. The CKCM-based activities used in the experimental group were developed and used by the researchers. The teaching was carried out by the same teacher in both groups. The Structure and Properties of Substance Unit consists of six topics. One of these issues is "Chemical Industry in Turkey". A cross-section of the implementations in the experimental and control groups is presented in Table 2 below.

Table 2. A Cross-Section of the Implementations in the Experimental and Control Groups.

	Control Group	Experimental Group
Pre-test	The Entrepreneurship Scale was administered as a pre-test before starting the practice. The scale was given 40 minutes.	The Entrepreneurship Scale was administered as a pre-test before starting the practice. The scale was given 40 minutes.
Implementation	The courses were taught according to 5Es learning model. The related activities in the courses are taken from the 8th grade Science Textbook proposed by the Ministry of National Education. In the engage phase: "What is the chemical industry for students?" The question was asked and then the question was asked about the relationship between the related pictures and the textbook. Thus, the preliminary information of the students was revealed with the brainstorming technique. The students were informed about the gains and informed about the subject. In the explore phase: The students were given the opportunity to read the related section in the Science textbook. Then, the table of import and export products in the textbook was examined to the students. In this way, students gained awareness about this issue. From the past to the present, students have realized that the chemical industry has gone through different stages. In the explain phase: The teacher was given feedback on the part of the students to correctly structure the information they reached in the second stage. With the question-answer technique, the students' knowledge about the subject was reinforced. In addition, the life story of our businessmen, Sakip Sabanci, was shown to the students. This video tells the students about the entrepreneurial direction of Sakip Sabanci. In the elaborate phase: The relationship of the knowledge of the students about the chemical industry with the other courses was mentioned. Use of this topic in daily life was questioned with the help of question and answer technique. The benefits and disadvantages of influenza vaccines and antibiotic use were discussed. The students were asked what influenza vaccines and antibiotic (drug) use might have in connection with entrepreneurship.	In the experimental group, the courses were processed according to the Common Knowledge Construction Model. The study material was developed by researchers. In the Exploring and Categorizing phase: Students were asked questions about the key concept to reveal their prior knowledge about the subject. In order to connect with the chemical industry, firstly the students were asked about their industrial and industrial concepts. Then the chemical industry related "Word Association Test "was distributed to students. Then, the students were informed about the gains. In Constructing and Negotiating phase: In the first stage, students' preliminary information and misconceptions about the subject were determined. In the preliminary information of the students, there was a class discussion for correcting the wrong information. From the past to the present, a study leaf about the products imported and exported in our country was distributed to students. Then, a video about production, import and export of large-scale companies in our country was shown to the students. In this video, important elements about entrepreneurship were discussed among students. At this stage, the elements of the nature of science were also discussed indirectly. In Translating and Extending phase: Based on the videos they watch students in the chemistry of the future which will be an important profession in Turkey were discussed. In addition, as a country, what could be imported in the future was discussed. After this event, an entrepreneurial event was prepared based on six-hat thinking technique. Sakıp Sabancı's life story was shown to the students. A concept cartoon related to influenza vaccines has been distributed to the students in the pharmaceutical sector. Thanks to this activity, influenza vaccines, which are socio-scientific subjects, were pointed out. The students were taught the subject effectively.

	In evaluate phase: In order to find out whether the students learn the topic, the multiple-choice and open-ended evaluation questions in the textbook are solved.	In Reflecting and Assessing phase: Such complementary assessment and evaluation techniques as "Word Association Tests", "Structured Grid" and "Diagnostic Tree" were utilized to evaluate the learning's outputs.
Post-test	After the application; Entrepreneurship Scale and Semi-Structured Entrepreneurship Interview was applied as a post-test.	After the application; Entrepreneurship Scale and Semi-Structured Entrepreneurship Interview was applied as a post-test..

Data Collection Tools

In this study, the Entrepreneurship Scale (ES) developed by Gömleksiz and Kan (2009) was used as a data collection tool. The scale has 41 items. The Cronbach Alpha reliability coefficient of the scale was 0.90, the KMO value was 0.794 and the Bartlett test result was 2611.626. Bartlett test results were found to be significant at 0.05 level (Gömleksiz & Kan, 2009). This scale consists of three dimensions: creativity, critical thinking and entrepreneurship skills. In this scale, there are 13 items related to creativity, 12 items related to critical thinking and 16 items related to entrepreneurship skills. For the purpose of the study, items related to entrepreneurship skills were sampled. In deciding on the implementation of the items in the entrepreneurship dimension of the scale, the opinions of three faculty members who are specialized in the field and have many publications about the field were taken. The reliability of the scale was re-calculated by the researchers. Entrepreneurship scale was distributed to 250 students studying eight grades. The data were calculated by using SPSS program and the reliability coefficient of the scale was calculated as 0.83. This value shows that the scale is reliable (Büyüköztürk, 2011).

The second data collection used in the research was Semi-Structured Entrepreneurship Interview. The interviews were conducted to determine the opinions of the eighth grade students about entrepreneurship and entrepreneurship skills and to verify the entrepreneurship scale. An interview form consisted of eight open ended questions were prepared and then this was reduced to five questions. The reason for decreasing the number of questions to five is that the third, sixth and seventh questions do not fit the purpose of the research question. These questions were removed by the researcher in the interview form. The final version of the interview form is presented to the expert opinion again. The consistency, conformability, credibility and transferability instead of the validity and reliability of the data were examined (Denzin & Lincoln, 1994). The data obtained by the semi-structured interview and the themes and codes examined by three different researchers were determined. The, another expert looked into the themes to ensure the credibility of the research. To ensure transferability, the appropriate sampling was employed and the reader was given a detailed explanation. Unprocessed data, findings and interpretations were recorded for the validity of the study.

Data Analysis

The quantitative data were analysed with SPSS 21.0. The score ranges were categorized as effective (2.34-3.00), less effective (1.67-2.33) and ineffective (1.00-1.66). Descriptive and content analysis was used to analyse semi-structured interviews. The interviews were recorded. The recorded interviews were transferred to the electronic environment and re-listened to ensure that there were no missing or incorrect transfers. Then, a thematic framework was determined for descriptive analysis. It was determined which students' views were within the scope of the theme and the findings were supported by direct quotations. For the descriptive analysis to be valid, the data collected at the end of the interviews were summarized and the students were asked to confirm whether the summaries were correct whether there was anything they would like to add and remove. To maintain the reliability of the data, the data transferred to the electronic environment were examined and coded by different experts. The codes were then compared for accuracy. In order to determine the consistency of the codes put forth by different researchers, the disagreement and consensus points were calculated with the formula that Miles and Huberman (1994) stated. Thus, inappropriate themes and coding were reorganized or removed, depending on the purpose of the research. The compliance rate of the semi-

structured interview data was found to be 82%. The fact that the compliance ratio is above 70% indicates that the analysis is reliable (Miles & Huberman, 1994). The themes were identified and presented in a table.

FINDINGS

The arithmetic means and standard deviation values of the pre and post test scores of the experimental and control group students are given in Table 3.

Table 3. Arithmetic mean and standard deviation values of the pre-post-test scores of the entrepreneurship scale of experimental and control group students

	Items	Experiment Group				Control Group			
		Pre test		Post test		Pre test		Post test	
		$\overline{X}$	Ss	$\overline{X}$	Ss	$\overline{X}$	Ss	$\overline{X}$	Ss
1	Entrepreneurship allows me to evaluate opportunities.	2.42	0.76	2.84	0.47	2.41	0.73	2.44	0.71
2	Entrepreneurship teaches that I have to trust myself to do a job	2.35	0.80	2.61	0.68	2.42	0.72	2.81	0.49
3	Entrepreneurship creates awareness of fulfilling my responsibility	2.31	0.81	2.80	0.50	2.31	0.88	2.48	0.77
4	Entrepreneurship makes me dream of what I want to achieve.	2.38	0.79	2.72	0.61	2.38	0.81	2.64	0.56
5	Entrepreneurship allows me to self-direct myself while working.	2.28	0.84	2.76	0.43	2.24	0.83	2.56	0.65
6	Entrepreneurship teaches me to think fast when making decisions.	2.12	0.83	2.44	0.82	2.32	0.90	2.44	0.76
7	Entrepreneurship teaches that I have to follow my decision to be successful.	2.40	0.81	2.56	0.71	2.20	0.82	2.60	0.64
8	Entrepreneurship teaches that I have to finish what I started.	2.40	0.81	2.72	0.61	2.42	0.75	2.60	0.64
9	Entrepreneurship teaches that I must be patient to overcome the obstacles I face.	2.48	0.87	2.80	0.57	2.24	0.92	2.52	0.71
10	Entrepreneurship teaches that it is necessary to take risks to achieve.	2.00	0.91	2.60	0.70	2.12	0.83	2.44	0.76
11	Entrepreneurship allows me to easily convince others	2.20	0.81	2.60	0.64	2.32	0.75	2.60	0.57
12	Entrepreneurship provides me with courage to explain my work.	2.32	0.80	2.56	0.71	2.38	0.81	2.56	0.76
13	Entrepreneurship teaches that I have to listen to my friends' thoughts respectfully.	2.42	0.83	2.80	0.57	2.32	0.85	2.52	0.65
14	Entrepreneurship helps me to produce new ideas and to realize them.	2.12	0.83	2.68	0.55	2.28	0.84	2.48	0.77
15	Entrepreneurship allows me to learn about different professions and what they do.	2.36	0.88	2.60	0.70	2.40	0.76	2.52	0.65
16	Entrepreneurship helps me to identify the challenges that I may encounter when performing a given task.	2.28	0.84	2.60	0.64	2.32	0.80	2.72	0.61
	Total	2.30		2.67		2.32		2.55	

When Table 3 is examined, it is seen that the pre-test scores of experimental group students are at less effective (1.67-2.33) and Effective level (2.34-3.00). The items that are rated as less effective are 3, 5, 6, 10, 11, 12, 14 and 16, respectively. On the other hand, the items rated as effective are 1, 2, 4, 7, 8, 9, 13 and 15. It was determined that the arithmetic mean of the post test scores of the experimental group students was at the effective level. In the post test, it was found that the two items with the highest arithmetical average in the entrepreneurship scale were items 1 and 3. In summary, the students' entrepreneurship skill points were gathered at a less effective level and their average score was 2.30. The post-tests showed that the arithmetic averages of the students' entrepreneurship scale scores were at an effective level. Total mean arithmetic score of the scale was found to be 2.67.

When Table 3 is examined, it is seen that the answers of the students in the control group to the entrepreneurship scale are at least effective (1.67-2.33) and effective (2.34-3.00) level. The items 3, 5, 6, 7, 9, 10, 11, 13, 14 and 16 are at least effective level whereas items 1, 4, 8, 12 and 15 are at effective level. It was determined that the control group students' arithmetical means of all items were effective in the pre-test. The highest arithmetic mean was found to be the 2nd item ($\overline{X}$ =2.81) and the 16th item ($\overline{X}$ =2.72).

As a result, the arithmetic mean of the pre-test total scores of the control group students on the entrepreneurship scale was 2.32, whereas the pro-test was 2.55. In the pre-test, the arithmetic averages of the students' entrepreneurship scale scores were found to be effective whereas in the pro test, they were at the least effective level.

The answers of the experimental and control group students to the Semi-Structured Entrepreneurship Interview are presented below.

Table 4. Students' responses to the question of "What can you say about the characteristics of the entrepreneurial person?"

Theme	Codes	Experiment Group						Control Group					
		D_1	D_2	D_3	D_4	D_5	D_6	K_1	K_2	K_3	K_4	K_5	K_6
Characteristics of Entrepreneurial person	Makes trade	+	+	+	+	+	+	+	+	+	+	+	+
	Innovative	+	+	+	+	+	+	+	+	+	+	+	-
	Takes risks	+	+	-	+	+	-	-	+	+	-	+	-
	Confident	+	+	+	+	+	+	+	+	-	-	+	-
	Organised	+	+	+	+	-	+	+	-	+	-	-	-
	Good communication skills	+	+	-	+	-	-	+	+	-	-	-	+
	Persuasive	+	+	-	-	-	+	+	+	-	-	-	-
	Resilient	-	+	+	-	+	-	-	+	-	-	-	-
	Open to trainings in related field	-	-	-	-	+	+	-	-	-	+	-	-
Characteristics of a proactive person	Social	+	+	+	+	+	+	+	+	+	+	+	+
	Sincere	+	+	+	+	+	+	+	+	+	+	+	+
	Friendly	+	+	-	-	-	+	+	+	+	+	+	+
	Helpful	+	-	+	+	-	-	+	+	+	-	-	+
	Sociable	+	+	-	+	+	-	-	+	-	-	-	+

Students of experimental group defined the characteristics of entrepreneur as someone who makes trades, feels confident and is passionate about innovation. Student D_3 stressed trade code and added: "*An entrepreneur is a person who is engaged in commerce and who has tried all sorts of ways to perform the assigned task.*" Five students stressed the code of being organised. For instance, D_1 stated: '*Entrepreneurs are the people who can make the employees in the companies perform their duties without interrupting and who can organize the group.*' Two students expressed their opinions as: "*These people are experienced because they have been managers before, they are not entrepreneurs.*" "*They are the managers of the companies of their families.*" K_4 teased out the code of the training in their relevant field: "*They have also become entrepreneurs when they graduate because they have been trained to be so at university.*"

All students in the experimental group explained the characteristics of the proactive students as social, friendly and sincere. D_2 said: "*Anyone who can easily adapt to any environment and who is interested in a variety of activities is a proactive person.*' D_5 indicated: '*The proactive person is sympathetic, and full of love and affection.*" Other students the used codes of easy-going and helpful code. D_1 expressed as follows: '*They are people who do their best.*'

Table 5 presents the experimental and control group students' thoughts about the founder of Apple, Steve Jobs and the creator of Facebook social networks Zuckerberg.

Table 5. Students' responses to the question of 'Do you think people like Zuckerberg, or Steve Jobs are entrepreneurs? Why?'

Themes	Codes	Experiment Group						Control Group					
		D_1	D_2	D_3	D_4	D_5	D_6	K_1	K_2	K_3	K_4	K_5	K_6
Yes	Take risks	+	+	+	-	-	+	+	+	-	+	+	-
	Has the courage	+	+	+	-	-	+	-	+	+	-	+	-
	Innovative	+	+	+	-	-	+	+	-	+	-	+	+
	Problem-solvers	+	+	-	+	-	-	-	-	-	+	+	-
	Determinant	+	-	-	+	-	-	+	-	-	-	+	-
	Good organizers	-	-	-	+	-	+	-	+	-	-	-	-
	Research skills	+	-	+	-	-	-	-	-	-	-	+	-
	Auto-control	+	+	-	-	-	-	+	-	-	+	-	-
No	Experience	-	-	-	-	-	-	-	-	-	+	-	+
	Family business	-	-	-	-	+	-	-	-	-	+	-	+
	Education in the related field.	-	-	-	-	-	-	-	-	-	+	-	-

Four students of the control group found Steve Jobs and Zuckerberg entrepreneurs. They have teased out these people's ability to take risks, have the courage and innovation skills. D_2 and D_3 said: "*They did not know if touchpad phones would be so popular, but they took a risk and produced*" "*Zuckerberg designed Facebook and he is constantly updating it. This shows that he is innovative.*" Three students in the control group stressed the problem-solving and research skills of Jobs and Zuckerberg. Some students said that Jobs and Zuckerberg are not creative. They argued that these people were successful because they had family business, received education in this area and had experience. D_5 said "*The parents of these people founded the company, and they have the experience and learned to become entrepreneurs.*"

Four students from the control group defined Jobs and Zuckerberg as entrepreneurs whereas two did not regard them as so. Those who think that they are entrepreneurs said these people were innovative, could take risks and has the courage. K_3 said: "*They have created stuff that no one has ever heard so that's why I could say that they are creative.*" Participants emphasized the researcher identity of these people. K_5 expressed: "*They have researched into the ideas that could create good opportunities in future and designed their products accordingly.*" Two students who said Jobs and Zuckerberg were entrepreneurs argued that these people inherited their family business and gained experience within the time. K_4 and K_6 stated: "*These people are not entrepreneurs but experienced since they have the experience of being managers." "They are the managers of the companies that their families transfer.*" K_4 said: "*They have also become entrepreneurs because they have studied in departments related to this field.*"

Table 6 presents students' ideas with regard to science education and how it can contribute to the entrepreneurial skills of students.

Table 6. Students' responses to 'What are the contributions of the science education projects to the entrepreneurial skills of students?'

Theme	Codes	Experiment group						Control Group					
		D_1	D_2	D_3	D_4	D_5	D_6	K_1	K_2	K_3	K_4	K_5	K_6
The Contribution of Projects to Entrepreneurship	Research	+	+	+	+	+	+	+	+	+	+	+	+
	Taking Responsibility	+	+	+	+	+	+	+	+	+	+	+	+
	Exchanging ideas	+	+	+	+	+	+	+	+	+	+	+	+
	Finding research topics	+	+	+	+	+	+	+	+	+	+	+	+
	Analysing the projects	+	+	-	+	-	-	-	+	-	-	+	-
	Getting support from teacher	+	+	+	-	-	-	+	-	-	-	-	+
	Taking a decision on Project topic	+	+	+	-	+	-	+	-	-	+	-	+
	Project presentation	+	+	+	-	+	-	+	+	+	-	-	-

When Table 6 is examined, it was stated that all the students in the experimental group conducted projects in science education and they conducted research, took responsibility, fond a project topic and exchanged ideas with friends. D_3; stated: "*Before I start the project, I try to find out a potential topic. Then, I discuss it with my friends and I take the opinion of my teacher. Then I allocate the tasks among of my friends.*" D_5 said "*In the project, we ask people what tasks they want to be responsible for and share the tasks.*"

During the interviews with the control group students, students expressed following code: doing research, taking responsibility, finding a project topic and exchanging ideas with their friends. K_4 expressed "*We assign a responsibility to very project member.*" K_1 expressed the importance of findings "*We choose one of the situations that is problematic.*'. K_2 said "*Once we have identified research problem, we looked into how we can address it.*"

The opinions of the students in the experimental and control groups about the importance of self-confidence and courage for entrepreneurship are given in Table 7.

Table 7. Student responses to the questions of 'Do you think that self-confidence and being courageous are important for being a entrepreneurial?'

Theme	Codes	Experiment Group						Control Group					
		D_1	D_2	D_3	D_4	D_5	D_6	K_1	K_2	K_3	K_4	K_5	K_6
Important issues about the Entrepreneurship	Effective Communication Silks	+	+	+	+	+	+	+	+	+	+	+	+
	Speaking effectively	+	+	+	+	+	+	+	+	+	+	+	-
	Being Competitive	+	+	+	+	+	+	+	-	+	+	-	+
	Marketing skills	+	+	+	+	-	-	+	-	-	+	-	-
	Reassuring others	+	+	-	+	+	-	-	+	+	-	+	-
	Taking decisions about future	+	+	+	+	-	-	+	-	-	+	-	-
	Creating brand	-	-	-	+	+	+	+	+	-	-	-	-
	Being optimistic	+	+	+	-	-	-	-	+	-	-	-	-

The experimental group stated that self-confidence and courage are important for entrepreneurship. The students stated that these concepts provide effective communication and contribute to risk taking and competition. D_2 said; "*If the person is not self-confident and courageous, s/he may give up when faced with challenges and cannot succeed. Therefore, being self-confident is important to overcome the difficulties.*" D_6 said; "*The confident people can easily say their thoughts without hesitation and easily explain*". D_1 stressed the importance of taking risk; "*Self-confident people stand behind their ideas and thoughts.*"

The control group students pointed out the importance of effective communication and risk taking. K_2 stated that "*An entrepreneur knows how to communicate easily.*" Four students expressed the competitiveness concept. K_1 said: "*Someone who is not brave and self-confident will not be considered as competitive even if they come up with new products. They will not be taken into consideration.*"

The opinions of the experimental and control group students on the content and evaluation of the elective entrepreneurship course are given in Table 8.

Table 8. Student responses to the question of 'If you had an elective course on entrepreneurship in your school, how would you like the content and evaluation of this course?

Themes	Codes	Experiment Group						Control Group					
		D_1	D_2	D_3	D_4	D_5	D_6	K_1	K_2	K_3	K_4	K_5	K_6
Couse Content	Introducing the characteristics of skilled people	+	+	+	+	+	+	+	+	+	+	+	+
	Contemporary topics	+	+	+	+	+	+	+	+	+	+	+	+
	Introducing the lives of entrepreneurial people	+	+	+	+	+	+	+	+	+	+	+	+
	Project- based content	+	+	-	-	+	+	+	+	+	-	-	-
	Introducing institutions that support entrepreneurs	+	+	-	+	-	+	+	+	+	+	-	-
	Introducing legislation about entrepreneurship	-	+	+	+	+	-	+	-	-	+	+	-
Assessment	Process-oriented assessment	+	+	+	+	-	+	+	+	-	+	-	+
	Assessment with open-ended questions	+	-	-	+	-	-	-	-	-	-	+	-
	Performance assessment	-	+	+	-	+	+	+	+	-	-	-	
	Presentation assessment	+	+	+	-	+	-	+	+	+	-	-	+
	Result oriented assessment	-	-	-	-	-	-	-	-	-	-	+	-
	Mixed assessment	+	+	+	-	-	+	+	-	-	+	-	-

Experiment group students stressed that an entrepreneurship course should include contemporary topics and introduce the lives of entrepreneurs. D_5 said; "*From the past to the present, the lives of those who are entrepreneurs should be included and their important achievements should be explained.*" D_3 said; *"The characteristics that should be in an entrepreneurial individual should be included.'* The experimental group students stated that the understanding of elective entrepreneurship course should be process-oriented, open-ended questions and performance-based. D_2 said; "*Assessment should be extended over time and based on performance*". D_6 addressed to the importance of performance based assessment*: 'The assignments we do should assess our performance.'*

The interview group students made similar explanations with the experimental group about the content of the elective course. K_3 stressed that characteristics of qualified people should be included in curriculum: "*The characteristics of an entrepreneur should be explained.*" K_5 said; "*What the past entrepreneurs have done can be presented.*" The control group students stated that there should be process-oriented evaluation of the elective course. K_1 made the following suggestions *"Instead of taking an exam, the work we produce throughout the course should be evaluated."*

DISCUSSION AND CONCLUSION

In this study, the effect of CKCM based science teaching on the entrepreneurial skills of eighth grade students was investigated. In this context, the entrepreneurship scale and the findings were discussed.

Discussion of the Findings in Entrepreneurship Scale and Conclusion

While the arithmetic average of total entrepreneurship scale pre-test scores of the experimental group students was 2.30, it was seen that the arithmetic average increased to 2.67 in the post test. In addition, after the implementation, the arithmetic mean of all items in the scale was determined as "*effective*" (Table 3). These findings suggest that CKCM-based science teaching in the experimental group is effective on eighth grade students. This may be related to the project-based research conducted by students. Additionally, teacher showed videos about the lives of entrepreneurial individuals which could have potentially played a role. One of the social characteristics of entrepreneurial individuals is to take responsibility (MEB, 2013). In the CKCM-based entrepreneurship education, there may be an increase in the awareness of the students because students are required to produce projects that focus on achievement. Ersoy and Başer (2009) argued that

teachers should do activities to motivate the classroom, should provide opportunity for students to make free trials and should prepare flexible learning-teaching environment. Similarly, the research of Seikkula-Leino (2011) suggested that cooperative learning, learning by doing and experiencing, peer teaching, inviting entrepreneur individuals to the school, group work, drama technique and project-based learning are activities for developing entrepreneurship skills. In this study, peer teaching, drama technique and the invitations of the entrepreneurial individuals played an important role in the arithmetic average of the last test entrepreneur scale score as being "*effective*". At the same time, inclusion of activities that serves the entrepreneurial skills in the second and third stages of the CKCM may have played a role.

While the arithmetic average of the total pre-test scores of the control group students was 2.32, it found that the arithmetic average increased to 2.55 in the post-test. The arithmetic means of all items in the scale were determined as "*effective*" (2.34-3.00) after the implementation to the control group (Table 3). This means the current teaching model in the control group has an effect on the entrepreneurial skills of the eighth-grade students. Changes after the implementation to the control group is believed to result from teachers handling the biographies of individual entrepreneurs in Turkey. In addition, the current teaching model that consist of active participation of students and guidance of teachers is also effective (Ayvacı & Bakırcı, 2012; Çelik & Avcı, 2018; Yeşilpınar-Uyar & Doğanay, 2018). The use of drama technique in the deepening phase of the current teaching model is thought to be effective on entrepreneurship. In many studies, it has been found that drama technique is effective in developing students' entrepreneurship characteristics (Selanik-Ay &Acar, 2016). In addition, it was found out that the experiment-based research included in the current teaching model improved students' self-confidence, eliminated their feelings of curiosity, increased their analytical thinking skills, and motivated them to learn (Çelik, Özbek & Kartal, 2013; Karakuş, 2009). Since all skills directly or indirectly affect entrepreneurship, science teaching with existing teaching model has an effect on students' entrepreneurship skill scores.

As a result, science teaching based on the present teaching model (5Es learning model) conducted in the control group and CKCM conducted in the experimental group was found to be effective on the entrepreneurship skills of secondary school 8th grade students. Arithmetic mean difference of pre-test and post-test total scale scores of the experimental group students was found to be 0.37, and the difference was 0.23 in the control group. This finding suggests that CKCM is more effective on the entrepreneurial skills of the students. This may be related to the use of different teaching materials in CKCM based science teaching (analogy, concept caricature and worksheets etc.) and the use of scenarios of entrepreneurship skills as part of the teaching materials.

Discussion of the Findings of Semi-Structured Interviews

It was found that the experimental and control group students made similar explanations about the characteristics of the entrepreneur individuals (Table 4). Students mentioned the characteristics of an entrepreneurial individual as; trade, risk-taking, persuasiveness, persistence, self-confident and effective communication skills. In addition to this, students have explained the concept of entrepreneur as being social, helping people, communicating easily with others, being friendly and sincere. Students were affected by the entrepreneurial people in their environment. In addition, visual and written media may have affected this result (Avcı, 2016). Research of Kuşay (2017) mentioned that internet-based social media environments consisting of user uploaded contents for sharing purposes mobilizes the creativity and entrepreneurship features of users rather than mutual communication. In the interview, three students in the experimental group concluded that being proactive is necessary for entrepreneurship, but entrepreneurship is not a prerequisite for being proactive. On the other hand, it is noteworthy that none of the control group students mentioned this conclusion. This can be explained by the CKCM based science teaching experimental group received because CKCM focuses on skills such as practice, analysis and synthesis starting from higher-order thinking skills (Biernacka, 2006; Ebenezer & Connor, 1998; Wood, 2012). The control group students could not reach this level despite their activities and practices.

The second question of the interview investigated the opinions of the experimental and control group students about the technological device producer firm owners' and the social media founders' entrepreneurial characteristics. Five of the six students interviewed in the experimental group indicated that the owners of technology firms had entrepreneurial characteristics. In the control group, four of the six students interviewed stated that these people have entrepreneurial characteristics (Table 5). According to students, these people are entrepreneurs because they are courageous, innovative, determined and problem-solving. In addition, students emphasized the importance of having research shills. On the other hand, some students stated that the social media or big firm owners are not entrepreneurial individuals because they inherited their family business. According to the interviews, students believe that entrepreneurs do not initially have an entrepreneurial character, their entrepreneurial character is related to the training they received in their fields. It was determined that the experimental group students' explanations about this question were more comprehensive. It can be argued that watching the videos reflecting the lives of the domestic and foreign entrepreneurs in the experimental group is effective in the formation of this difference (Çetin, 2015; Deveci, 2016). As teenagers, these students are looking for people who will be role models when they choose their professions (Akdeniz, 2009). For this reason, the presentation of the entrepreneurial individuals and visual presentation of them may have attracted the attention of the students. It can be argued that experimental group students know more about the entrepreneurial individual and they can easily identify the people with entrepreneurial characteristics.

Third question looks into whether project assignments have contributed to the entrepreneurial skills of the students in the experimental and control groups. The students stated that they collaborated with their teachers and peers at every stage of developing the project. After the feedback of the teacher, if the project subject was appropriate, tasks were distributed among group members and data collection, report generation, presentation were completed. When these explanations are taken into consideration, one can argue that students know the steps of the scientific method. It is possible to say that the project and performance assignments given by the teachers in the previous years were effective in following the steps of the scientific method. The exhibition of the student projects that are supported by the Ministry of National Education and Scientific and Technological Research Council of Turkey at the end of the year within the scope of science fairs may have also been effective. Students conduct research under the supervisor of the teacher in order to develop projects. In this process, it can be said that sharing instructions about the scientific research method with the students is effective.

The fourth interview question was about the self-confidence of the experimental and control group students in entrepreneurship. Experimental and control group students explained the concepts of trust and courage were associated with competitiveness, effective communication and taking risk. The students of the experimental group stated that self-confidence and courage are important for entrepreneurial skills as these two concepts can gain them different points of views (Table 7). In the experimental group, six thinking hats technique was used in the third stage of CKCM. The technique of six thinking hats gives students the opportunity to look at a subject from different perspectives (Bakırcı, Çalık & Çepni, 2017; Can, 2005). In this way, students use logic rather than acting with emotions. In addition, instead of memorizing information, students are encouraged to think in different ways by using their creativity. This technique helps them think practically and discover new ideas in decision making. The six thinking hats technique provides important results in problem solving (Altıkulaç-Akhan, 2010; Güneş, 2012).

The last question of the interview looked into experimental and control group students' thoughts about what should be included in the content of an entrepreneurship course. More than half of the students in the experimental group stated that the content of the course should be project based, include current topics and the life stories of entrepreneurial individuals. Additionally, students wanted to be introduced with the organizations which support the entrepreneurial individuals, to talk about the legislations on entrepreneurship and to explain the characteristics of qualified individuals. On the other hand, more than half of the control group students made similar comments with the experimental group students. Experimental group students stated that evaluation of students should be based on

modern assessment and process-oriented assessment techniques. Although the two groups of students made similar statements, the experimental group students emphasized the process-oriented assessment. In these explanations of both groups' students; it is thought that the different intelligence areas of the students and the assessment habits of them are effective. Özkan (2007) point out that not only the teacher but the child himself, his/her parents, and even the other students are important in the assessment of the students. In addition, it was stated that it would be more accurate to carry out a process-oriented assessment in which student and parents are part of the assessment, instead of the product-oriented evaluation (Bakırcı, Kara & Çepni, 2016). Akamca (2003), on the other hand, emphasized that students should be assessed in different ways because they learn differently.

RECOMMENDATIONS

In order to observe the effect of the Common Knowledge Construction Model on Entrepreneurial skills, research interrelated with science education as well as with other units or topics of the field should be conducted based upon different levels of teaching.

In the literature, it can be said that the scale and questionnaire on entrepreneurship skills of secondary school students are limited. Therefore, questionnaires and scale development studies can be conducted for secondary school students.

Based upon the aforementioned premises further studies should be conducted prospectively in order to determine the exact relationship between entrepreneurship and Common Knowledge Construction Model.

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