Science-based entrepreneur project development process for pre-service science teachers:

difficulties faced*

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ABSTRACT

This study used a phenomenological research design to determine the difficulties faced in the science-based entrepreneur project development process for pre-service science teachers.. Qualitative data were obtained through interviews conducted with ten pre-service science teachers. The data were analysed using an inductive thematic analysis. The results indicated that pre-service science teachers have most difficulty 'making decisions on one of the innovative ideas' and 'making predictions about unexpected situations'. They also have difficulties 'calculating the cost as a result of design or work analysis', 'identifying if the idea already existed (similarity analysis)' and 'making decisions on the required materials, tools, services'. These results show the need for pre-service science teachers to communicate with other institutions and organisations.

KEYWORDS

Science education

Teacher education

Entrepreneur project

INTRODUCTION

The progression of entrepreneurship is becoming more important for national economies and from the entire European perspective. Entrepreneurship is seen as the way to grow the European Union's social and economic well-being (Seikkula-Leino et al. 2012). In recent years, the concept of entrepreneurship has gained attention in the field of education, a key concern being the types of practices of the teacher training institutes.

In the narrow sense, entrepreneurship education is defined as preparing students for the business world. In the broadest sense, it has been described as the process of acquiring a range of skills that can be applied in all areas of life and bring a social and economic return to the individual (European Commission 2011). Entrepreneurship education as some of their aims coincide. In entrepreneurship education, students' preferred learning approaches are active, just as in science education (Deveci & Çepni 2014). Entrepreneurship education presents students with career options for their future professional lives. In a similar manner, science education plays a significant role in the occupational choice of middle school students (Beca 2007). Thus, it makes sense

for entrepreneurship education to be integrated with the middle school science curriculum. Through entrepreneurship education an innovative learning space has been created in science courses (Koehler 2013), and it is argued that science education can be integrated with entrepreneurship education (Ugwu et al. 2013). Furthermore, it has been forecast that in the 21st Century science teachers will face many problems unless they have knowledge and experience of entrepreneurship and entrepreneurial characteristics (Achor and Wilfred-Bonse 2013).

At present, many teachers lack entrepreneurship education and thus are unaware of the correct approach to teaching entrepreneurship (European Commission 2009). Entrepreneurship education requires good teacher training (European Commission 2013). It has been explained that, in general, teacher training must focus on capacity building, creating awareness, general knowledge and skills about entrepreneurship rather than on specialisation in the economic and management sciences (Owhotu 2015). These are important training activities to increase pre-service teachers' knowledge and experience of entrepreneurship education. The project development process related to entrepreneurship identified that active pre-service teachers needed to allocate more time to this training. An example is the science-based entrepreneur project development process proposed to pre-service science teachers by Deveci and Çepni (2014), which comprises:

- Observing the environment and determining the requirements of society
- Propounding innovative ideas comprising the requirements
- Making decisions on one of the innovative ideas
- Identifying if the idea already existed (similarity analysis)
- Exposing the differences from other products (originality)
- Specifying the target group (widespread impact)
- Making decisions on required materials, tools, services, etc.
- Identifying and eliminating the possible risks that may be encountered (plan B)
- Analysis of the aims of the product design or service (work analysis)
- Number and quality of people who work at stages of production and marketing
- Calculating the cost as a result of design or work analysis
- Determining the foreseen average sales target (per year, month, or day)
- Making predictions about unexpected situations
- Making decisions on how to access the customer
- Making decisions on advertising channels
- Presenting the project in a report form.

In the science education literature, many studies have examined the opinions of science teachers about entrepreneurship education (Bolaji 2012; Bacanak 2013; Koehler 2013). Other studies have emphasised the importance of entrepreneurship education in science education (Adeyemo 2009; Ezeudu et al. 2013; Ugwu et al. 2013). One study also investigated the opinions of pre-service science teachers (Amos & Onifade 2013). As shown in the related literature, no research has been done to determine the difficulties faced in the entrepreneur project development process for pre-service science teachers (Buang et al. 2007; Adeyemo 2009; Bolaji 2012; Bacanak 2013; Ezeudu et al. 2013; Deveci & Çepni, 2014). This study aims to fulfil that purpose.

METHOD

A qualitative study was carried out to examine the research questions. The study can be described as descriptive and exploratory, and used a phenomenological research design to interpret and to clarify the experiences of the individuals involved in the research (Ary et al. 2010).

PARTICIPANTS

The study included ten pre-service science teachers who were educated in science teacher programmes at the faculty of education in a state university in the 2013/14 academic year in Turkey. Each of the participants was selected on a voluntary basis. Ten pre-service science teachers were selected via simple random sampling from among 26 pre-service science teachers participating in the entrepreneur project development process. The participants were all between 21 and 25 years old. Six were female and four were male.

IMPLEMENTATION PROCESS

The study was conducted during a three credits selective course provided in the fifth semester of the pre-service science teachers' course at a state university. During the implementation of this course the students benefited from the entrepreneur project development process suggested by Deveci and Çepni (2014). The process took 14 weeks. The first week involved observing the environment and determining the requirements of society. This was followed by propounding innovative ideas comprising the requirements. In the second week, decisions were made on one of the innovative ideas, and the third week involved identifying if the idea already existed (similarity analysis). In the fourth week the differences from other products (originality) were exposed, and in the fifth week the target group was specified (widespread impact). The sixth week involved making decisions on required materials, tools, services,

etc. In the seventh week the possible risks that could be encountered were identified and eliminated (plan B). The eighth week involved analysis of the aims of the product design or service (work analysis). In the ninth week the number and quality of people who would work at the stages of production and marketing were identified. In the tenth week the calculation of the cost as a result of the design or work analysis was completed, and in the eleventh week the foreseen average sales target was determined (per year, month, or day). In the twelfth week predictions were made about unexpected situations, in the thirteenth week decisions were made about advertising channels and how to access customers and, finally, in the fourteenth week the project was presented in a report form.

DATA COLLECTION

A semi-structured interview form was prepared in order to determine the difficulties faced in the science-based entrepreneur project development process for pre-service science teachers based on the theoretical dimension of the research. The semi-structured interview used as the data collection instrument adapted 14 items from the entrepreneur project development process, as suggested by Deveci and Çepni (2014). At the end of the entrepreneur project development process, interviews with each pre-service science teacher were held via the semi-structured interview form in sessions ranging from 10 to 15 minutes. During the interview, the questions were asked in order and the responses were tape-recorded by the researcher. The questions included on the interview form were composed of the stages of the science-based entrepreneur project development process (Table 1).

DATA ANALYSIS

Data were analysed by descriptive analysis. For this, sound recordings made during the interviews were firstly transcribed to Word, and then redundant data were excluded from the analysis. Themes were created based on the common ideas and the findings were displayed, illustrated by direct quotations from the participants. To hide the identity of theparticipants, they were numbered as K1, K2, K3, etc.. Direct quotations are provided to increase the reliability of the study.

RESULTS

This section gives the results regarding difficulties faced by pre-service science teachers at each stage of the entrepreneur project development process (Table 2).

As seen in Table 2, the difficulties most commonly faced were, in order: making decisions on one of the innovative ideas (5), making predictions about unexpected situations (5), analysis of the current situation (4), calculating the cost of the product or service (4), identifying the tools, equipment and services needed (3), making decisions on the number and qualifications of the people who are to work at the stages of production and marketing (1) and determining the foreseen average sales targets (per day, month or year) (1).

The most challenging stage was established to be 'making decisions on innovative ideas' (5). The pre-service teachers specifically faced difficulties in creating innovative ideas, identifying if any idea created already existed, and making decisions as to which of the ideas created should be determined. For instance, K1 commented, *'we've put a lot of thought into the ideas in order to come*

TABLE 1. STAGES OF SCIENCE-BASED ENTREPRENEUR PROJECT DEVELOPMENT PROCESS

Stages	**Difficult**		**Because:**
	Y*	N**	
1. Observing the environment and determining the requirements of society and propounding innovative ideas comprising the requirements			
2. Making decisions on one of the innovative ideas			
3. Identifying if the idea already existed (similarity analysis)			
4. Exposing the differences from other products (originality)			
5. Specifying the target group (widespread impact)			
6. Making decisions on required materials, tools, services, etc.			
7. Identifying and eliminating the possible risks that may be encountered (plan B)			
8. Analysis of the aim of the product design or service (work analysis			
9. Number and quality of people working at stages of production and marketing			
10. Calculating the cost as a result of design or work analysis			
11. Determining the foreseen average sales target (per year, month, or day			
12. Making predictions about unexpected situations			
13. Making decisions on how to access customers and on advertising channels			
14. Presenting the project in a report form			

*Y:Yes, **N: No

TABLE 2. DIFFICULTIES FACED BY PRE-SERVICE SCIENCE TEACHERS AT EACH STAGE OF THE ENTREPRENEUR PROJECT DEVELOPMENT PROCESS

Stage	Participants	f
1. Observing the environment and determining the requirements of society and propounding innovative ideas comprising the requirements	–	–
2. Making decisions on one of the innovative ideas	K1, K2, K3, K4, K6	5
3. Identifying if the idea already existed (similarity analysis)	K2, K4, K5, K7	4
4. Exposing the differences from the other products (originality)	–	–
5. Specifying the target group (widespread impact)	–	–
6. Making decisions on required materials, tools, services, etc.	K2, K5, K8	3
7. Identifying and eliminating the possible risks that may be encountered (plan B)	–	–
8. Analysis of the aims of the product design or service (work analysis)	–	–
9. Number and quality of people working at stages of production and marketing	K5	1
10. Calculating the cost as a result of design or work analysis	K1, K2, K9, K10	4
11. Determining the foreseen average sales target (per year, month, or day)	K9	1
12. Making predictions about unexpected situations	K1, K2, K3, K6, K7	5
13. Making decisions on how to access customers and on advertising channels	–	–
14. Presenting the project in a report form	–	–

up with original ones, and the decision-making part has been a real challenge for us', while K3 said, 'We've had a bit of difficulty at the first stage, that is identifying an innovative idea, as we came up with multiple ideas. Then, we decided to proceed with the idea that addresses a rather broader target audience and that is rather more promising in terms of results and returns.'

The second most challenging stage was 'making predictions about unexpected situations' (5). The pre-service teachers stated that they faced particular difficulties predicting what to expect and what situations might be encountered in the future, and also stated that they suffered from a lack of experience. For instance K6 commented, *'Our poor knowledge about the market, given the fact that we had never tried anything similar before, certainly caused us to face difficulties in predicting unexpected situations,' while K3 said, 'We didn't know what to expect or predict as to whether it would be beneficial to everyone or harmful to some – given the facts that it would address a numerous number of people and some had a rheumatic infection condition.'*

It was also observed that the pre-service teachers faced difficulty at the stage of 'analysing the current situation' (4). This stage necessitated conducting a literature review or establishing the current situation in respect of the intended service. The pre-service teachers mentioned the requirement to conduct an extremely broad amount of research, which took a considerable amount of time, and also mentioned the difficulty encountered with keeping track of the rapid flow in the market. For instance, K7 made the following comments: *'There were a lot of products that were already in the market with similar characteristics to those of the one we have created; therefore, we had to spend a lot of time on the research we had to conduct in order to find out what innovative and distinguishing characteristics we could add to our product for originality and competitiveness,'* while K2 commented, *'We had difficulties in analysing the current situation since the project addressed an extensive and broad target audience; that is to say, the project was about designing an educational website, so we had to go through and review all existing websites featuring the same theme.'*

Another challenging stage for the pre-service teachers was 'calculating the cost of product or service' (4), in respect of which they experienced challenges due to their lack of sufficient knowledge of economics. They also stated that they had particular difficulty because the cost was constantly calculated to be extremely high. For instance, K9 made the following comments:

'*We determined the headcount of staff we needed for the project. However, it was truly difficult to balance the cost to be incurred for the compensation of our workers and the materials and equipment to be used for bag manufacturing and the income we could expect to derive from the sales of the product. The costs were excessive even though we wrote off the insurance cost, stating it would be covered by TUBITAK, on account of which we had to raise the sales price of the bag. So this stage has been extremely challenging ...'*

while K2 commented, *'We had problems with determining the cost because we thought up the prices we set for event development and marketing developed events to the educational community and if that happens, all the labour and efforts we've put into it would be in vain.'*

The other stages at which pre-service teachers faced the most difficulties were established to be 'identifying the tools, equipment and services needed' (3), 'making decisions on the number and qualifications of the people who are to work at the stages of production and marketing' (1) and 'determining the foreseen average sales targets (per day, month or year)' (1). In particular, the stage of identifying the tools, equipment and services needed challenged the pre-service teachers as to what method they should adopt as they had to work with novel concepts, methods and techniques. For instance, K2 made the following comments: *'We were to proceed using a novel method so there were no precedent sources to which we could refer. Therefore, we had to place the very arguments we had applied during the pre-service programme on our website,' while K5 commented,, 'It was challenging for me that I had no previous knowledge as to the tools and equipment required for the project and that I had to work with concepts that were totally new to me.'*

Furthermore, it was observed that the pre-service teachers had difficulty deciding on the number and qualifications of the people who were to work at the stages of production and marketing since the project could not be actually implemented on account of the lack of financial support. For instance, K5 made the following comments: *'It was a bit difficult to precisely identify the staff headcount needed since we didn't have the chance to actually go live with the project (which had to remain on paper, only)'.* As for determining the foreseen average sales targets (per day, month or year), it was observed that the pre-service teachers were indecisive about what product would be taken as the benchmark for the purpose of setting a sales target. For instance, K9 made the following comment: *'It was not really probable that the sales target we could set for the object of our project was similar to that applicable for a commercially marketed bag. And we were uncertain about how low the target we could set for our bag should be.'*

DISCUSSION AND CONCLUSION

At the end of the process of entrepreneur project development, based on the interviews conducted, it was observed that pre-service science teachers faced particularly difficult stages, such as making decisions on one of the innovative ideas and making predictions about unexpected situations. Moreover, it was determined that pre-service teachers have problems at the stages of calculating the cost as a result of design or work analysis and identifying if the idea already existed (similarity analysis). These results show that pre-service science teachers have difficulty translating into practice the concepts of 'entrepreneurship' and 'economy' which they are not familiar with, because they have no experience of the education process related to entrepreneurship. The study by Bacanak (2013) supports this conclusion. He stated that science teachers do not have the necessary information in respect of entrepreneurship.

Examining these results, it can be seen that pre-service science teachers have insufficient knowledge and experience of the concepts of economy, occupation, marketing, etc., related to entrepreneurship. At the same time, they are reluctant to seek support from experts such as economists and businessmen in the process of entrepreneur project development. A study conducted by Bulunuz (2011) found that pre-service science teachers had the lowest participation in science projects at university level. Consequently, it is clear that the education process must provide more experience to pre-service science teachers. Armstrong and Tomes (2000) stated that an important role of entrepreneur instructors is to evaluate the entrepreneurship of university students in terms of science-based innovation. Kleppe (2002) suggests that it may be useful to provide courses that aim to enhance the understanding of pre-service teachers about entrepreneurship and innovation in K-12 teacher education in a similar manner.

Based on these results , it can be suggested that pre-service science teachers should benefit from an educational process related to entrepreneurship. For this, teacher educators should firstly take more responsibility for entrepreneurship education. In particular, they must guide pre-service teachers about visiting different institutions and organisations. They must also continuously inform and mediate pre-service teachers concerning the support received from experts working in other faculties and colleges in the university. ■

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