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A Comparatıve Look at the Concepts of Creatıvıty and Scıentıfıc Creatıvıty

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Abstract
This study was conducted with the participation of 32 pre-service science teachers attending the second year of a faculty of education in a Turkish university. Participants were asked two open-ended questions, the reliability of which was established by the two researchers. The main problem of the study concerns pre-service science teachers' definitions of the concepts of creativity and scientific creativity. It was found that pre-service science teachers' definitions of the two concepts were on the whole similar to those provided in the relevant literature, but the there were also missing points, especially in the definition of scientific creativity.
Keywords: creativity, scientific creativity, science education, pre-service teachers

Introduction

Creativity is often used in one of two senses. One of these is 'discovery', and the other is 'innovation'. Even this distinction, however, is not final. Innovation may be used in reference to something considered novel because it was not previously seen where the innovation took place, or with reference to an absolute novelty, in the sense of creating something or some idea that that did not previously exist (DeBono, 2002). Creativity is present at birth, but develops only in a suitable context and environment. Providing this appropriate context and environment to children at an early age is only possible if there are educational processes that are supportive of creativity (Yıldırım, 2014).

Unlike in general creativity, scientific knowledge, scientific skills and scientific attitudes are very closely related in scientific creativity (Jo, 2009). Scientific creativity involves the production of novel and useful ideas or products in order to solve a problem or meet a need (Kanlı, 2014). Park (2011) argues that t-scientific creativity comprises three dimensions: creative thinking, scientific knowledge, and scientific research ad investigation skills.

Hu and Adey (2002) developed a 'scientific creativity model' for field-specific creativity, which consists of the dimensions of flexibility, originality, fluency, thinking, imagination, science problems, science phenomena, science knowledge and technical products. Problem solving, hypothesis formation, experimental design, and technical innovation all require some form of scientific creativity (Lin, Hu, Adey ve Shen, 2003). For scientific creativity, 'fluency can be defined as all ideas that could be scientifically accepted, flexibility can be defined as fluent ideas that are created using different fields and approaches, and originality can be defined as fluent ideas that make up a certain percentile within the said group' (Demir, 2014).

Meador (2003) argues that thinking and debating like a scientist is necessary to develop creativity and scientific process skills, that creative thinking and scientific process skills are intertwined, and that people who are able, practice their scientific process skills improve their scientific creativity. It is important that pre-service teachers, who will be leading classes in the future, have creative problem solving experience, and have a cognitive perception of that experience (Reiter-Palmon and Illies, 2004). In this context, it is important to examine pre-service science teachers' views on creativity and scientific creativity. Thus, this study aims to examine pre-service science teachers' definitions of the concepts of creativity and scientific creativity.

Methodology

The study was conducted with the participation of 32 pre-service teachers attending the science education program of a Turkish university. Participants were asked two open-ended questions on how to define the concepts of creativity and scientific creativity. The qualitative data collected was then coded into various categories, and analyzed on the basis of frequency distributions. In addition, the validity of the questions was examined and established by the two researchers.

Results

Findings of the study are reported in Table and Table 2 below. These tables report the qualitative data on pre-service teachers' answers, in the form of the frequency distributions of the codes.

Table 1. Codes regarding the concept of creativity

Codes	**n**
Creating different/original ideas/works	21
Having an imagination	7
Creating ideas	3
Thinking skills	3
Talent	2
Putting knowledge to use	2
Creating different products from different materials	2
Having a different perspective on daily events	2
Being practical	2
Designing experiments	2
Caring about societal problems	2
Other	19

As Table 1 shows, pre-service science teachers mostly used the expressions 'creating different/original ideas/works', 'having an imagination', 'creating ideas', and 'thinking skills' in their definitions of the concept of creativity.

Table 2. Codes regarding the concept of scientific creativity

Have you heard of the concept before?	**N**
Yes	6
Codes	**n**
Thinking about scientific issues	17
Inventing things	8
Creating new ideas/different things	9
Fields such as physics, chemistry, biology, science, and math	6
Conducting experiments	6
Conducting research	5
Interest in technology	4
Helping other people	2
Forming hypotheses	2
Creating something useful	2
Being different	2
Design	2
Other	9

As Table 2 shows, six of the pre-service teachers reported having heard about the concept before, and the phrases most commonly used by pre-service teachers in defining scientific creativity were 'thinking about science', 'inventing things', 'creating new ideas/different things', 'fields such as physics, chemistry, biology, science, and math', 'conducting experiments', 'conducting research', and 'interest in technology'.

Conclusion and Discussion

Piaget took imagination seriously and argued that using imagination, it can be seen that what looks like separate disciplines actually have common foundations (Voneche, 2003). In Maslow's hierarchy of needs, creativity is expressed in the 'self-actualization' need of a person, which is located at the very top of the pyramid, which indicates that for creativity to emerge, other needs have to first be met (Maslow, 1968, cited by Baykal, 2003). Expert knowledge and creative thinking skills are not sufficient to bring about creativity, as these components need to be complemented by internal motivation (Ünlüer, 2014). Teaching people ways to express themselves helps improve their creativity (Özcan, 2007). In the re-structuring of education programs, creative thinking is encouraged using a student-centered approach, and class environments, methods, and techniques that would help improve the creative thinking skills of the students by encouraging creative thinking are designed (Orçan, 2013). Maslow defines creativity as ability to self-express (Hanley and Abell, 2002).

This study found that pre-service teachers mostly identified the characteristics of: 'thinks/interprets differently/originally', 'curious', 'enjoys research', 'has imagination', 'observant', 'self-confident', 'questions/enjoys questioning', 'sociable, not shy', 'open to new ideas', 'knowledgeable', 'Farsighted', 'enjoys exploration', 'patient', 'enjoys learning', 'open to criticism', and 'talented', as the characteristics of a creative person. These descriptions indicate that the creative person is considered to have a very wide and varied range of characteristics. This does not mean, however, that a creative person needs to have all of these characteristics at once. According to Edmonds, Weakley, Candy, Fell, Knott, and Pauletto (2005), creative people try to develop new techniques and new forms, and the creative process needs to be combined with rigorous laboratory work.

Use of laboratory time, one that integrates critical and creative thinking processes and in which logical thinking about science issues and learning is achieved, is an effective method in science education (Koray and Köksal, 2009).

Designing a creative educational environment by making changes in the classroom or in the schoolyard can be very important in developing creativity (Öztürk Aynal, 2010). When creative children's behaviors are misinterpreted at school or at home, this might blunt their creativity (Ünlüer, 2014). It is important that pre-service teachers, who will be leading classes in the future, have creative problem solving experience, and have a cognitive perception of that experience (Reiter-Palmon and Illies, 2004). Creativity is present at birth, but develops only in a suitable context and environment. Providing this appropriate context and environment for children at an early age is possible if there are educational processes that support creativity (Yıldırım, 2014). According to Fisher (2013), to develop creativity, children should be taught that the process of problem solving is more important than the end result. In this context, it is important that pre-service science teachers are trained to recognize and develop creativity skills.

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