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Perception of Scientific Creativity and Self-Evaluation among Science Teacher Candidates

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Abstract
This study was performed with the participation of 20 teacher candidates from the science education department of a university in Turkey. During the study, the teacher candidates were asked two questions, one of which was open-ended, while the other was multiple choice. The validity of these questions developed for this study was evaluated by two expert researchers. The aim of this study was to determine how science teacher candidates defined scientific creativity, and how they assessed themselves in terms of scientific creativity. The study results indicated that the science teacher candidates considered themselves to be somewhat inadequate in terms of scientific creativity, and that they were unable to fully understand or interpret this concept.

Key concepts: scientific creativity, teacher candidate, science education

Introduction

In an age of innovation, it is important to create and be a part of the world's own rhythm. Innovative opinions require creativity, as well as a different perspective of events. Creativity involves both scientific thinking and daily experiences (Farooq, 2008). The pioneers of this age of innovation tend to be individuals who can scientifically develop creative opinions, and implement these opinions in daily life. Problem-solving, forming hypotheses, designing experiments, and technical innovation all require a certain form of scientific creativity (Lin, Hu, Adey, and Shen, 2003). In this context, scientific creativity in education occupies a particularly important place.

Scientific creativity can be defined as the process of developing new and suitable ideas and/or products through the use of connotative and analogical thinking as well as insight, and based on preexisting knowledge on a given field (Kanlı, 2014). In their studies, Demir (2014) and Demir and Şahin (2014a, 2014b) emphasized that possessing knowledge on a particular field is important for scientific creativity. Hu and Adey (2002) similarly noted that field knowledge is an important requirement for scientific creativity, and developed a "scientific creativity model" for field-specific creativity. This model consists of the following dimensions: fluency, flexibility, originality, imagination, thinking, scientific knowledge, scientific problem, scientific fact, and technical product.

Fluency, which is one of the characteristic dimensions of the scientific creativity model, refers to the number of original ideas a person can produce (Hu and Adey, 2002), while flexibility refers to the number of categories or category changes in which the person's responses are classified (Yarbrough, 2011), and originality refers to the ability to create unusual or unique ideas (Yeloğlu, 2007). Originality, which is an important component of creativity, is the product of both imagination and independent thinking (Aslan, 2001). Based on these definitions, fluency can also be defined as representing the collection of ideas that are scientifically correct, while flexibility can be defined as fluent thoughts formed in different areas and approaches, and originality can be defined as fluent ideas that enter into a certain percentage ratio within a relevant group (Demir, 2014).

Teachers play an undeniably important role in the development and education of societies. The better a society raises its teachers, the more these teachers will be able to transfer their knowledge and skills to their students. It is especially important for science teachers to think creatively by examining events from a scientific perspective. For this reason, we believe that it is particularly important to determine the scientific creativity of teacher candidates.

The aim of this study was to determine how science teacher candidates defined scientific creativity, and how they assessed themselves in terms of scientific creativity.

Methods

This study was performed with 20 science teacher candidates enrolled in the science education department of a university in Turkey. In this study, the science teacher candidates were asked two questions, one of which was open-ended, while the other was multiple choice. Qualitative data obtained with the open-ended question, "What does the concept of scientific creativity mean?" were classified according to predefined codes and themes, and the data were interpreted based on the number of times the codes were repeated. The science teacher candidates were also asked the self-evaluation question, "How would you rate yourself in terms of scientific creativity?" to which they provided one of five possible answers; the teacher candidates were required to select the answer they considered the most valid. The validity of the questions developed for this study was evaluated by two expert researchers.

Results

Data obtained in this study were organized and presented in tables. Table 1 shows the frequency of themes and codes in the qualitative data obtained from the teacher candidates, while Table 2 indicates the self-evaluation results of the teachers based on their responses to the multiple choice question with five possible answers.

Table 1. Themes and codes regarding the definitions of scientific creativity provided by the teacher candidates

Scientific Creativity Themes	Codes	N
Originality	Originality	0
	Difference/innovation	8
Scientific Knowledge	Science/Scientific thinking	10
	Scientific knowledge	0
	Knowledge	3
Flexibility	In-depth examination	0
	Establishing relations with other ideas	0
Fluency	Producing numerous ideas	0
	Establishing relations with other ideas	0
	Producing ideas	3
Product	Making inventions	1
	Designing	1
	Developing methods	1
	Performing experiments	1
Imagination	Imagination	1

As shown in Table 1, the science teacher candidates used various different terms when describing the concept of scientific creativity. Looking at the frequency of these terms, it is possible to see that the terms “science/scientific thinking” and “difference/innovation,” were commonly used; while the terms “originality,” “scientific knowledge,” “in-depth analysis,” “establishing relations with other ideas,” and “producing numerous ideas” were not used. On the other hand, the terms “knowledge,” “making inventions,” “designing,” “developing methods,” “performing experiments,” and “imagination” were used sparingly.

Table 2. Self-evaluation of teacher candidates with respect to scientific creativity.

Fairly Adequate	Adequate	Partially Adequate	Inadequate	Fairly Inadequate	No Answer
0	7	7	4	0	2

As shown in Table 2, when asked to self-evaluate their scientific creativity, the science teacher candidates generally described themselves as having a medium-level of scientific creativity.

Results and Conclusion

Based on the definitions provided in the literature, scientific creativity can be described as a *thinking skill that enables individuals to produce numerous original ideas in different areas by utilizing an interdisciplinary and innovative perspective in science, technology, and arts (esthetics) in order to resolve a particular problem* (Demir, 2014). An evaluation of the science teacher candidates’ responses with respect to the fluency, flexibility, originality, scientific knowledge, imagination, and product dimensions of scientific creativity indicated that teacher candidates generally mentioned themes relating to scientific knowledge and originality, while making little mention of the themes of fluency, product, and imagination, with no mention of flexibility. This reveals that the science teacher candidates tended to perceive the concept of scientific creativity in a superficial way, and that they were not very familiar with this concept.

Another result of this study was the observation that the science teacher candidates generally considered themselves as having a medium-level of scientific creativity. This was possibly because they did not consider themselves to be adequate in terms of scientific creativity, or because they might not have fully grasped the definition of this concept.

The study results indicated that the science teacher candidates considered themselves to be somewhat inadequate in terms of scientific creativity, and that they were unable to fully understand or interpret this concept. Educational applications and practices focusing on creative thinking have an important influence on the scientific creativity and scientific skills of students (Kurtuluş, 2012). We believe that this study is important in that it allows science teacher candidates – the teachers of the future – to gain an awareness about their own level of scientific creativity, thereby providing them with a basis from which they can further improve their potential scientific creativity. In this context, we believe that it is necessary to conduct further studies aiming to assess and improve the scientific creativity of science teacher candidates. A study involving laboratory applications and open-ended creativity activities, Demir (2014) observed that such activities contributed to the development of scientific skills and scientific creativity among teacher candidates.

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