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# A Situatıonal Study for the Identificatıon of Pre-Service Science Teachers' Creatıve Thinking and Creatıve Scientıfic Thinkıng Skills

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**Abstract**
This study was conducted with the participation of 33 pre-service teachers attending the department science teaching of a Turkish university. Participants self-reported using the 'Self-assessment of creativity scale' and were asked to choose the most appropriate answer to the five-choice self-assessment question 'Which category best describes your creative scientific thinking skills?' The main problem of the study concerns pre-service science teachers' self-assessments of their creative thinking and creative scientific thinking skills. The findings of the study showed that pre-service teachers were sometimes uncertain about their creative thinking skills, and saw their scientific creativity as only partially satisfactory.
**Keywords**: scientific creativity, pre-service teachers, science education, creativity

## Introduction

Creativity, imagination, art and play are among the major concepts used by Vygotsky, and these concepts have become important tools in cultural psychology (Pelaprat, 2012). According to Maslow, creativity is related to the self-realization potential of an individual (Hanley and Abell, 2002). Early scientific inquiries on creativity and creative thinking were conducted by the American Psychology Association in the 1950s, and these studies have advanced and continued to this day. Originality, which is an important component of creativity, results from qualities such as imagination and free thinking (Aslan, 2001).

Creativity involves both science and daily life (Farooq, 2008). Problem solving, hypothesis formation, experimental design and technical innovation all require some form of scientific creativity (Lin, Hu, Adey and Shen, 2003). Scientific creativity requires adding to the accumulated knowledge to create a new product (Liang, 2002). Scientific knowledge is in part a product of imagination and creativity (Khishfe and Abd-El-Khalick, 2002). Demir's (2014) and Demir & Şahin's (2014a, 2014b) studies focus on the importance of specialized knowledge for scientific creativity. Hu and Adey (2002), on the other hand, developed the "scientific creativity model", which predominantly applies to field-specific creativity. Rationality, which is an important criterion for scientific creativity, is defined as all ideas that could be scientifically accepted, flexibility is defined as rational ideas that are created using different fields and approaches, and originality is defined as rational ideas that make up a certain percentile within the said group (Demir, 2014). Scientific creativity in turn is motivated by a need, a requirement, or a desire for problem solving (Terzioğlu, 1993, as cited by Aktamış and Ergin, 2006).

It is very important for science teachers to be able to think creatively by examining scientific facts, and to unearth the science embedded within daily life through creative thinking. Therefore, identifying the creative scientific thinking skills of pre-service science teachers is a worthy undertaking. For this reason, this article's main problem concerns pre-service science teachers' self-assessments of their own creative thinking and creative scientific thinking abilities.

## Methodology

The study was conducted with the participation of 33 pre-service teachers attending the science teaching program of a Turkish university. Participants self-reported using the 'Self-assessment of creativity scale'. The 'How creative are you?' test, developed by Raudsepp, was adapted for use in Turkey by Sungur (1997). Later, Gülel (2006) had the test examined by linguists for fluency in terms of Turkish language and literature, and found the Cronbach's alpha reliability coefficient to be 0.761 for all 50 items. In addition, pre-service science teachers were asked to answer a self-assessment question with five choices, 'Which category best describes your creative scientific thinking skills?', by choosing the most appropriate category.

## Results

The study's findings are reported in two separate tables. Table 1 reports the findings of the 'Self-assessment of creativity scale' at the item level, and Table 2 reports findings on the self-assessment of creative scientific thinking.

 

**Table 1. 'Self assessment of creative thinking' item scores**

| Items of the scale | Strongly disagree | Disagree | In between or don't know | Agree | Strongly agree |
|---|---|---|---|---|---|
| S1.It would be a waste of time for me to ask questions if I had no hope of obtaining answers. | 51,5 | 27,3 | 6,1 | 9,1 | 6,1 |
| S2. I occasionally voice opinions in groups that seem to turn some people off. | 12,1 | 36,4 | 27,3 | 18,2 | 6,1 |
| S3. I feel that I may have a special contribution to give to the world. | 3,0 | 18,2 | 24,2 | 36,4 | 18,2 |
| S4. People who seem unsure and uncertain about things lose my respect. | 12,1 | 27,3 | 12,1 | 30,3 | 15,2 |
| S5.On occasion I get overly enthusiastic about things. | 9,1 | 12,1 | 6,1 | 45,5 | 27,3 |
| S6. I rely on intuitive hunches and the feeling of 'rightness' or 'wrongness' when moving toward the solution of a problem. | 9,1 | 12,1 | 18,2 | 45,5 | 15,2 |
| S7. I like hobbies that involve collecting things. | 3,0 | 18,2 | 12,1 | 48,5 | 18,2 |
| S8. If I had to choose from two occupations other than the one that I now have, I would rather be a physician than an explorer. | 42,4 | 18,2 | 18,2 | 9,1 | 12,1 |
| S9. I have a high degree of aesthetic sensitivity. | 9,1 | 12,1 | 39,4 | 27,3 | 9,1 |
| S10. I am much more interested in coming up with new ideas than I am in trying to sell them to others. | 9,1 | 9,1 | 24,2 | 42,2 | 15,2 |
| S11. In evaluating information, the source of it is more important to me than the content. | 9,1 | 15,2 | 39,4 | 30,3 | 6,1 |
| S12. One's own self-respect is much more important than the respect of others. | 6,1 | 12,1 | 3,0 | 15,2 | 63,6 |
| S13. I like work in which I must influence others. | 6,1 | 18,2 | 27,3 | 27,3 | 21,2 |
| S14. People who are willing to entertain 'crackpot' ideas are impractical. | 6,1 | 18,2 | 54,5 | 9,1 | 12,1 |
| S15. When a certain approach to a problem doesn't work, I can quickly reorient my thinking. | 3,0 | 21,2 | 18,2 | 42,4 | 15,2 |
| S16. I am able to more easily change my interests to pursue a job or career than I can change a job to pursue my interests. | 9,1 | 18,2 | 48,5 | 9,1 | 15,2 |
| S17. I can frequently anticipate the solution to my problems. | 3,0 | 18,2 | 12,1 | 48,5 | 18,2 |
| S18. Only fuzzy thinkers resort to metaphors and analogies. | 6,1 | 21,2 | 60,6 | 12,1 | 0 |
| S19. I frequently begin work on a problem which I can only dimly sense and not yet express. | 6,1 | 21,2 | 30,3 | 21,2 | 21,2 |
| S20. I feel that hard work is the basic factor in success. | 21,2 | 9,1 | 15,2 | 18,2 | 36,4 |
| S21. I know how to keep my inner impulses in check. | 12,1 | 9,1 | 9,1 | 39,4 | 27,3 |
| S22. I resent things being uncertain and unpredictable. | 9,1 | 33,3 | 18,2 | 33,3 | 6,1 |
| S23. The trouble with many people is that they take things too seriously. | 6,1 | 15,2 | 24,2 | 21,2 | 33,3 |
| S24. I can easily give up immediate gain or comfort to reach the goals I have set. | 15,2 | 9,1 | 48,5 | 15,2 | 12,1 |
| S25. I'm attracted to the mystery of life. | 12,1 | 12,1 | 9,1 | 45,5 | 21,2 |
| S26. I always work with a great deal of certainty that I'm following the correct procedures for solving a particular problem. | 9,1 | 9,1 | 15,2 | 42,4 | 24,2 |
| S27. I believe that a logical step-by-step method is best for solving problems. | 12,1 | 6,1 | 3,0 | 54,5 | 24,2 |
| S28. I spend a great deal of time thinking about what others think of me. | 15,2 | 42,4 | 21,2 | 9,1 | 12,1 |
| S29. It is more important for me to do what I believe to be right than to try to win the approval of others. | 3,0 | 21,2 | 15,2 | 30,3 | 30,3 |
| S30. I am able to stick with difficult problems over extended periods of time. | 3,0 | 18,2 | 27,3 | 36,4 | 15,2 |
| S31. I often get my best ideas when doing nothing in particular. | 12,1 | 18,2 | 24,2 | 24,2 | 21,2 |
| S32. When problem solving, I work faster analyzing the problem and slower when synthesizing the information I've gathered. | 12,1 | 15,2 | 30,3 | 30,3 | 12,1 |
| S33. Daydreaming has provided the impetus for many of my more important projects. | 12,1 | 3,0 | 18,2 | 39,4 | 27,3 |

 

| | | | | | |
|---|---|---|---|---|---|
| S34. I can get along more easily with people if they belong to about the same social and business class as myself. | 3,0 | 27,3 | 9,1 | 36,4 | 24,2 |
| S35. Intuitive hunches are unreliable guides in problem solving. | 21,2 | 30,3 | 27,3 | 9,1 | 12,1 |
| S36. I tend to avoid situations in which I might feel inferior. | 15,2 | 12,1 | 33,3 | 30,3 | 9,1 |
| S37. I like people who follow the rule "business before pleasure". | 9,1 | 15,2 | 27,3 | 36,4 | 12,1 |
| S38. I feel people who strive for perfection are unwise. | 12,1 | 24,2 | 18,2 | 30,3 | 15,2 |
| S39. It is important for me to have a place for everything and everything in its place. | 12,1 | 6,1 | 9,1 | 54,5 | 18,2 |
| S40. I don't like to ask questions that show ignorance. | 18,2 | 24,2 | 21,2 | 21,2 | 15,2 |
| S41. I rather enjoy fooling around with new ideas even if there is no practical payoff. | 15,2 | 15,2 | 12,1 | 36,4 | 21,2 |
| S42.Inability to solve a problem is frequently due to asking the wrong questions. | 21,2 | 6,1 | 18,2 | 36,4 | 18,2 |
| S43. It is a waste of time to analyze one's failures. | 57,6 | 15,2 | 9,1 | 12,1 | 6,1 |
| S44. At times I have so enjoyed the ingenuity of a crook that I hoped he or she would go scot-free. | 24,2 | 12,1 | 18,2 | 27,3 | 18,2 |
| S45. I frequently tend to forget things such as names of people, streets, highways, small towns, etc.. | 18,2 | 33,3 | 15,2 | 24,2 | 9,1 |
| S46. To be regarded as a good team member is important to me. | 15,2 | 9,1 | 9,1 | 39,4 | 27,3 |
| S47. I am a thoroughly dependable and responsible person. | 15,2 | 6,1 | 3,0 | 45,5 | 30,3 |
| S48. I prefer to work with others in a team effort rather than solo. | 9,1 | 15,2 | 33,3 | 21,2 | 21,2 |
| S49. I am frequently haunted by my problems and cannot let go of them. | 3,0 | 15,2 | 9,1 | 57,6 | 15,2 |
| S50. If I were a college professor, I would rather teach practical courses than those involving theory. | 18,2 | 3,0 | 3,0 | 9,1 | 66,7 |

As Table 1 shows, pre-service science teaches mostly gave positive answers to the questions, but answers given to some of the items were inconsistent. Pre-service teachers gave inconsistent answers to the following items: "*People who are willing to entertain 'crackpot' ideas are impractical; I have a high degree of aesthetic sensitivity; I am able to more easily change my interests to pursue a job or career than I can change a job to pursue my interests; Only fuzzy thinkers resort to metaphors and analogies; I resent things being uncertain and unpredictable; I can easily give up immediate gain or comfort to reach the goals I have set; I can get along more easily with people if they belong to about the same social and business class as myself; Intuitive hunches are unreliable guides in problem solving; To be regarded as a good team member is important to me.*"

**Table 2. Pre-service teachers' self-assessments of creative scientific thinking**

| Very satisfactory | Satisfactory | Partially satisfactory | Unsatisfactory | Very unsatisfactory | No answer |
|---|---|---|---|---|---|
| 1 | 7 | 18 | 6 | 0 | 0 |

As Table 2 shows, most pre-service teachers evaluate their creative scientific thinking abilities as only partially satisfactory.

**Conclusion and Discussion**

Sasser (2006) considers creativity, innovation and integrations to be parts of the same whole. Creativity can be defined as the ability to introduce a novelty or a difference to an issue, as well as using imagination and insight (Öztürk, 2004). Creative scientific thinking, on the other hand, is defined as the ability of an individual to generate numerous original ideas in multiple fields for the solution of a problem that requires solution, using a multidisciplinary and innovative approach to science, technology, and art (aesthetics) (Demir, 2014).

New technologies have the potential to influence approaches to creativity and innovative design, and this cultural change and technological transformation are reflected in the relationship between digital media, technology, and innovation (IJDCI, 2013). Creativity and innovation are effective learning methods that help create a constructive learning environment, which is necessary for students to practice their cognitive processing skills, to integrate earlier learning with new information, and to actively participate in class activities (Wyke, 2013). Educational practices generated by creative thinking have a significant impact on the creative scientific thinking and cognitive processing skills of students (Kurtuluş, 2012).

Teachers, who are in a sense leaders of the innovative age, can achieve innovative thinking to the extent that they can develop their creative thinking skills and transmit those skills to science. This is why it is crucial for pre-service teachers to develop self-awareness about their creative thinking and creative scientific thinking abilities. This study found that pre-service science teachers sometimes gave inconsistent answers to creativity questions, and evaluated their creative scientific thinking skills as only partially satisfactory. In summary, pre-

service science teachers do not see themselves as satisfactory in terms of creativity or scientific creativity. Therefore, it is important that faculties of education take steps to measure and develop these skills, and conduct more studies on the topic.

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