SCIENTIFIC CREATIVITY AND ITS MEASUREMENT

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Abstract

The main purpose of this study is to make an analysis in sight of the studies about scientific creativity and its measurement. In line with this purpose, initially the definition, components and scope of scientific creativity was explained theoretically. The study aimed to provide explanations based on the “Scientific Creativity Scale” developed by Hu and Adey (2002); the scale was based on Guilford’s (1987) “Structure of Intellect” (SOI) model and especially on divergent thinking. The Scientific Creativity Scale evaluates scientific creativity, unusual uses, problem exploration, product development, scientific imagination, problem solution, science experiment and product design aspects; and responses are evaluated in terms of fluency, originality and flexibility. In conclusion, studies conducted in Turkish sample indicated medium level scientific creativity scores.

Keywords: Creativity, measurement of scientific creativity, scientific creativity

Introduction

Creativity is among the primary skills aimed to be developed in the 21st century because the contribution of creative individuals to both economy and social life is a self-evident fact. Therefore, creativity is a concept related to not only scientists in the field of arts but also many other fields and scientists who work in those fields (Johnson, 2012; Noddings, 2013; DeJarnette, 2012). Hence, creativity does not have a monopoly on a talented minority of a subject area. Creativity could be defined as presenting new and different products as the last phase that is expected to be achieved by the individual’s knowledge, skills and cognition in the
cognitive, affective and kinetic processes. In other words, in all the cognitive, affective, kinetic areas—whether the individual demonstrates heavily emotional, kinetic or cognitive performance—s/he can realize all in a creative way. On the other hand, review of the related literature indicated that Torrance (1974) defined creativity as being sensitive towards “problems, obstacles, lack of knowledge, insufficient concepts, etc.; defining difficulties; looking for solutions; making guesses or establishing hypotheses regarding insufficiencies and testing them and retesting them by changing; and finally conveying the results”. In the SOI (‘Structure of Intellect, SOI) Model developed by Guilford (1987), a creative process produces three different contents or knowledge (visual, audial, symbolic, semantic, behavioral, kinetic), five different psychological operations (cognition, memory, divergent thinking, convergent production, assessment), product or new production in six different in forms matched and processed with one of them (units, classes, relationships, systems, transformations and implications). Similarities and differences of the divergent and convergent production concepts have been investigated in a detailed way for the first time in this model. According to the theory, divergent production is accepted identical to creativity. Creativity is the ability to look at the same event or phenomenon from the same aspect and to produce different or new products. The important point here is the ability to be able to think or produce different things despite looking from the same aspect.

Education is related to all fields, and all of us could be more or less creative. Creativity is considered to form a basis for science. In this regard, the concept of scientific creativity emerges, which could be defined as creative problem solving process and consequence. Scientific creativity requires using previous knowledge and field skills (İşler and Bilgin, 2002; Aktamış and Ergin, 2006). Things Archimedes experienced in the process of finding buoyancy of water and Fleming’s finding penicillin as a result of a number of experiments could be given as examples for this. More detailed examples could be given as follows:

“We can say that Archimedes found buoyancy of water accidentally while having a bath, and creativity might appear during a sudden lightning. In these kinds of cases, the individual’s brain is busy with the occupation of curiosity and problem solution. There was a problem in Archimedes’ brain, and he was
thinking about it constantly in order to solve it. Meanwhile, he discovered buoyancy of water in bath”.

“Fleming found penicillin accidentally during a number of experiments in laboratory, but still there was problem here and he was striving to solve it. That’s why evaluating these events as accidental is not right, because as seen in these examples, the individual’s mind, sense of curiosity, and pursuit of solving the problem led to these explorations”.

As it could be understood from these examples as well, scientific creativity as a topic that identifies and thus affects societies’ welfare in the globalizing economy is important (National Academy of Sciences, 2006). Like creativity, there is no consensus about a single definition of the concept of scientific creativity. Hu and Adey (2002) defined scientific creativity as the individual’s ability to explore an existing or previously unprecedented problem case, imagine various ways for solutions, and find new techniques for solutions. According to Sak and Ayas (2013), scientific creativity is producing an original and beneficial idea or product in the field of science. In this process, usefulness and originality are the two criteria that need to be possessed by scientific creativity. Wang and Yu (2011) defined scientific creativity as the ability to learn scientific information and scientific problem solving. It is interesting to note that several researchers have conducted research in the field of scientific creativity (Guilford, 1956; Singh, 1980; Sharma and Shukla, 1986; Hoover, 1994; Feldhusen, 1994; Hu and Adey, 2002)

Review of the related literature indicates that the components of scientific creativity are process (thinking and dreaming), character (fluency, flexibility and originality) and product (scientific problem, scientific phenomena, scientific information, technical product) according to Hu & Adey (2002) and input (personal sources such as motivation), process (scientific stages) and output (nature of the product) according to Stierna and Villalba (2009). As a result, scientific creativity seems to be associated with finding the problem, wondering, making guesses, establishing hypotheses, looking for solutions, understanding the world around, designing the testing cases, testing hypotheses, changing and reestablishing
hypoth ates, being able to solve problems, being sensitive to problems, and producing new scientific, technological and social thoughts.

Structures of the tests that are related to measuring scientific creativity involve scientific process skills. Especially finding problems, establishing hypotheses, testing or designing a creative experiment, solving problems, developing a creative product, etc. are the structures that are either the scientific process skills themselves or that involve these skills within themselves (Hu and Adey, 2002; Hu, Shi, Han, Wang and Adey, 2010; Sinha and Singh, 1987).

Based on the scientific model developed by Hu and Adey (2002), it is possible to say that here the important things are the development of ideas that emerged within imagination and richness of thinking enhanced by the integration of science, arts, technology disciplines with the aspects of fluency, flexibility, and originality, and the transformation to a product as information, problem, phenomena, and production (literary, visual, experimental, etc.).

![Figure 1. Hu and Adey (2002) The Scientific Structure Creativity Model (SSCM)](image)

The main purpose of this study is to make an analysis in sight of the studies on scientific creativity and its measurements. In line with this purpose, initially the definition, components and scope of scientific creativity was explained theoretically.
The study aimed to make explanations based on the “Scientific Creativity Scale” developed by Hu and Adey (2002) which is used commonly for the measurement of scientific creativity. The Scientific Creativity Scale (see Figure 1) evaluates scientific creativity in terms of uncommon uses, problem exploration, product development, scientific imagination, problem solution, science experiment, and product design aspects; and the responses are evaluated in terms of fluency, originality and flexibility.

As we mentioned before, the Scientific Creativity Scale developed by Hu and Adey (2002); it was adapted to Turkish by Kadayıfçı (2008) and Deniş-Çeliker and Balım (2012). SCS is composed of seven open-ended questions in relation to unusual uses (question 1), exploration of the problem (question 2), product development (question 3), scientific imagination (question 4), problem solution (question 5), science experiment (question 6), and product design (question 7). While the scores obtained from the SCS were evaluated in terms of fluency, originality and flexibility for the first four questions, the other questions are evaluated considering the flexibility and originality aspects. Reliability coefficient of the original scale developed by Hu and Adey (2002) was 0.89. Reliability coefficient of the scale adapted to Turkish by Kadayıfçı (2008) was 0.73; it was found 0.86 by Deniş-Çeliker and Balım (2012).

In line with the purpose of the study and as it was mentioned in the introduction section of this paper, the concept of scientific creativity was discussed with all its dimensions. Then, findings in the master’s and doctorate theses that utilized the Scientific Creativity Scale developed by Hu and Adey (2002) were analyzed.

In conclusion, Turkish sample indicated medium level scientific creativity scores. Another finding was that scientific creativity scores demonstrated no differences according to gender.

References


