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Investigation of Scientific Creativity of Eighth Grade Gifted Students

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Abstract

The purpose of this study is to investigate scientific creativity of eighth grade gifted students. Participants of the study included purposefully selected 20 eighth grade gifted students. They were applied WISC-R and they scored higher than 120 in order to be identified as gifted. After their selection, Scientific Creativity Test was applied to them. Therefore their scores were analyzed in terms of four aspects of creativity; fluency, flexibility, originality and elaboration. The mean of total scores (9.51) of the participants showed that scientific creativity levels of the participants were at average level but their scores on originality and elaboration factors were not enough to produce creative ideas. These findings are evidence for need of improving two factors of scientific creativity.

Key words: Scientific creativity, gifted students, science education

Introduction

Giftedness is a desired characteristic for everybody to function effectively in life. Based on the importance of the giftedness, identification and education programs were developed in different countries (Aljughaiman & Ayoub, 2013; Davis & Rimm, 2010; Johnsen & Corn, 2001). Giftedness is defined as intersection of academic ability, creativity and motivation (Renzulli & Reis, 1985). As a domain for academic ability, science education for gifted students takes a great deal of attention. In some studies, lists of the behavioral characteristics of gifted children in science were provided. As one of them, Johnsen's (2004, 8) study represented some characteristics in the fields of math and science, for example; gifted student in science and math "*is interested in numerical analysis*" and "*has a good memory for storing the primary features of problems and solutions*". These characteristics are only one aspect of giftedness; academic ability, but motivation and creative thinking should also be represented in science domain to identify a student as scientifically gifted. Motivation aspect of giftedness has long history of research (Siegle & McCoach, 2005; Ziegler & Heller, 2000). Similar to domain specificity discussion in giftedness, motivation of gifted students was also studied by taking into account domain differences. Different theoretical frameworks were applied to understanding domain specific motivation of gifted students. Some studied showed high level motivation of gifted students to learn science (Koksal, 2012; Koksal, 2013). As similar to giftedness and motivation, third aspect of giftedness; creativity should also be studied by applying domain specific frameworks. In this study investigating scientific creativity of gifted students is purposed.

Creativity aspect of giftedness is a well-studied subject in gifted literature (Cropley, 1993; Kaufman, Plucker & Russell, 2012; Petroviç, Trifunoviç & Milovanoviç, 2013). But some researchers thought that there should also be a distinction among general creativity and domain specific creativity including scientific creativity (Baer & Kaufman, 2005; Kind & Kind, 2007). Similar distinction was made by separating different types of creativity such as everyday creativity and scientific creativity by different researchers (Runco, 2004; Kaufman & Baer, 2004; Kaufman & Baer, 2009). Feist (2004) suggested a model to name creativity domains called as "domains of mind", in his model seven areas of creative thinking were involved: biology, physics, math, psychology, linguistics, art, and music. As seen in the model science disciplines; biology and physics are emphasized as creativity domains. Boden (2001) stated that new ideas that are surprising, intelligible and valuable are results of creativity process, similarly scientific creativity process also results in surprising, intelligible and valuable products. But scientific creativity has its own creativity process during inquiry activities. Inquiry process of science requires using scientific creativity to reach original solutions and products in its distinctive processes such as hypothesizing, inferring and predicting (Barrow, 2010). Hu and Adey (2002) defined scientific creativity as "*a kind of intellectual trait or ability producing or potentially producing a certain product that is original and has social or personal value, designed with a certain purpose in mind, using given information*". In scientific creativity process, giving continuous attention to and focusing on a problem occur as an explicit cognitive function (Dietrich, 2004). Therefore scientific creativity is an important field of creativity studies for giftedness.

In science curriculums, scientific creativity dimension is not emphasized enough in spite of its clear importance for gifted students. But scientific creativity includes problem solving, hypothesis generating, experiment designing and new techniques (Lin et al., 2003). Although Turkish science curriculum emphasized problem solving, experiment designing and hypothesis testing (Turkish Ministry of Education [MEB], 2005), scientific creativity is not directly purposed in the curriculum. In the literature majority of the studies either focused on ordinary students (Kitto, Lok, & Rudowicz, 1994; Doolittle, 1990) or applied general creativity frames on gifted students (Chein, 1982; Wang, 2012). However general creativity tests will not assess scientific creativity (Hu and Adey, 2002). Assessment of scientific creativity requires applying scientific performance content, based on this idea Hu and Adey (2002) developed an instrument to measure scientific creativity. In this study researchers investigated scientific creativity of eighth grade gifted students by using the instrument for informing science curriculum differentiation process for gifted students. The purpose of this study is to investigate scientific creativity of eighth grade gifted students.

Method

For the purpose of this study, descriptive quantitative research method was utilized. In the study one application of the scientific creativity test developed by Hu and Adey (2002) was done. The test was applied to purposefully selected 20 gifted eight grade students in a Science and Art Center located eastern part of the Turkey. The students were determined by WISC-R scores (higher than 120). The scientific creativity test was adapted into Turkish by Kadayıfçı (2008) who found reliability coefficient as .73 and made factor analysis in Turkish culture. In original form of the test seven aspects of scientific creativity were measured; styles of non-ordinary uses, problem discovery, product development, scientific imagination, problem solving, science experiments and product designing (Hu & Adey, 2002). Two of the questions were "how many different scientific uses of a glass can you find?" and "Suppose there was no gravity, describe what the world would be like?". All of the aspects were evaluated in terms of four aspects of creativity frame of Torrance and Goff (1989). In the frame, fluency, flexibility, originality and elaboration were involved.

Taking into account these points three raters gave points to the performances of the participants. In fluency evaluation, raters counted number of ideas while they counted number of the groups of the ideas counted in fluency evaluation. Following evaluation on originality included counting dissimilar ideas to the ideas of all the participants. Final point; elaboration was evaluated by counting components of original ideas. The agreement between the raters was calculated by using intra-class correlation (on-way random model). Based on the analysis, the agreement was found as .87 (p<.001). The agreement value was found enough to go further in the analysis.

Findings

The findings of the study included mean scores of the participants on the factors (fluency, flexibility, originality and elaboration). In table 1, the mean scores on the factors are represented per participant.

Table 1. The mean scores of the participants on the factors

Participant No	Fluency	Flexibility	Originality	Elaboration	Total
1	4.57	2.81	0.76	1.05	9,19
2	6.61	2.30	1.71	2.61	13,23
3	3.95	3.81	0.38	0.38	8,52
4	3.67	1.84	0.76	1.43	7,70
5	5.14	2.04	1.24	1.67	10,09
6	3.86	2.87	0.48	0.76	7,97
7	4.43	1.96	0.95	2.05	9,39
8	2.90	2.60	1.33	2.29	9,12
9	2.38	2.27	0.38	0.76	5,79
10	5.86	1.36	1.86	2.42	11,5
11	5.24	1.36	0.71	0.90	8,21
12	3.62	3.64	0.62	0.67	8,55
13	7.62	2.48	1.00	1.62	12,72
14	5.86	1.77	0.52	0.52	8,67
15	4.24	3.82	0.29	0.52	8,87
16	6.43	2.55	0.29	0.33	9,60
17	4.57	1.90	0.48	0.57	7,52
18	6.38	2.70	1.29	2.09	12,46

19	5.38	2.19	0.43	0.57	8,57
20	6.48	3.45	1.05	1.48	12,46
Total	4,96	2,49	0,83	1,23	9,51

As seen in Table 1, the participants represented 4.96 mean score for fluency, 2.49 for flexibility, 0.83 for originality and 1.23 for elaboration. There is a clear decrease in mean scores of the participants from fluency to originality. However elaboration dimension mean score is higher than originality score. The total scientific creativity scores of the participants ranged between 13.23 and 5.79. When looked at the mean of total scores (9.51), it is seen that scientific creativity levels of the participants are at average level. Twelve of the participants have lower scores than the average. At the same time, the scores of the participants on originality and elaboration were not enough to produce creative idea.

Discussion and Conclusion

The findings of the study showed us that eighth grade gifted students' scientific creativity performance were not as good as their performance in IQ tests. In spite of their high scores in fluency factor (number of ideas regardless quality consideration), originality factor does not reflect creative performance on scientific context. In addition, component number of original ideas (elaboration) is not enough to say that original ideas have higher component numbers than 2. Therefore it might be said that originality and elaboration factors are problematic aspects of scientific creativity of gifted eighth graders.

The findings of this study gave similar result to those of Hu and Adey (2002) that general scientific creativity scores of the students are at the average level. But Hu and Adey focused on ordinary ninth graders' scientific creativity levels, reaching similar findings with our gifted sample is an important evidence for gifted students' ability to represent higher scores than their own age level scores. Lin, Hu, Adey and Shen (2003) stated that giftedness is a prerequisite for creativity but there is no linear relationship between them. As understood from the findings and the literature, scientific creativity is more than being an cognitive variable as measured in IQ tests. In defining giftedness, Renzulli and Reis (1985) mentioned about three factors; academic ability, creativity and motivation. But science curriculums included strategies on only academic development, creativity aspect is not considered strongly. For the gifted students, curriculum differentiations should include adding strategies for increasing scientific creativity. Especially, originality and elaboration factors of creativity need to be considered for development. Creative problem solving strategies (Parnes, 1961) might be an alternative to improve the gifted students on these factors.

In this study, 20 gifted eight graders were involved; the readers should give attention to the number of the participants in making generalization. In addition gender difference should be studied for checking whether there is a difference between male and female students in terms of scientific creativity aspects or not. In this study four aspects of scientific creativity was considered another aspect of the creativity might be determined to take the findings of this study further.

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