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Designing Science Games and Science Toys from the Perspective of Scientific Creativity

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Abstract
This study was conducted with the participation of 21 pre-service science teachers attending the faculty of education of a university in Turkey. The study aims to evaluate pre-service science teachers' science games and science toy designs in terms of scientific creativity. Participants were given a four-week period to design science games or science toys to complement the contents of a biology course. The science games and science toys developed were then evaluated in terms of scientific creativity, using the following four criteria: "science knowledge, fluency, flexibility, and originality". The science games and science toys developed by the pre-service science teachers were found to be satisfactory in terms of science knowledge and flexibility, and unsatisfactory in terms of fluency. There was an inconsistent distribution in the dimension of originality.
Keywords: scientific creativity, science games, science toys, creative design

Introduction

Creative learning needs to be open-ended and student-centered, and requires teamwork. Science teaching, at its core, consists of in-class activities (models, designs and experiments) and out-of-class laboratory work (Kind and Kind, 2007). Scientific creativity, although different problems may require different creative thinking procedures, usually consists of problem formation and limitation, development of hypotheses for a solution, hypothesis testing, finding the results, and accepting, rejecting or modifying the hypothesis (Sönmez, 1993 cited by Aktamış ve Ergin, 2007). Based upon the different formulations provided in the literature, *creative scientific thinking can be defined as the ability to generate numerous original ideas in multiple fields for the solution of a problem that requires a solution, using a multidisciplinary and innovative approach to science, technology, and art (aesthetics)* (Demir, 2014).

Scientific creativity means using field-specific knowledge in combination with associational and analogical thinking to create new and useful products (Kanlı, 2014). Studies by Demir, (2014) and Demir & Şahin (2014a, 2014b), focus on the importance of field-specific knowledge for scientific creativity. The scientific creativity model and tests created by Hu and Adey (2002) consists of three major dimensions: process (imagination, thinking), trait (originality, flexibility, fluency), and product (science problem, science phenomena, science knowledge, technical product). Based on these formulations, fluency can be defined as all ideas that may 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).

Imagination is very important, especially in games, dramatization and toys. Imagination is usually described as seeing through the eyes of the mind, and plays a very important role in creating new ideas, in cognitive development and in learning (Kind and Kind, 2007). According to Amir and Subramaniam (2005), toys can be used by children of all ages to see and recognize science embedded in their daily lives. Teachers who use toys in their lesson plans think that the creativity, problem solving skills and creative mental skills of their students will improve. Indeed, according to Hossieni and Khalili (2011), learning programs created using a postmodern understanding, offer opportunities to create a flexible, pluralist environment for a creative and innovative approach to the problems of daily life.

The role of toys in early childhood science education is to help teach general concepts of science and associate them with events and objects in daily life, whereas in elementary and secondary education, students can design advanced science toys, or prepare science projects, based on the simple toys they have played with as children (Amir and Subramaniam, 2005). This study aims to evaluate pre-service science teachers' science game and science toy designs from the perspective of scientific creativity.

Methodology

This study was conducted with the participation of 21 pre-service teachers attending the science teaching program of the faculty of education of a university in Turkey. Pre-service teachers were given a four week period to design science games or science toys to complement the contents of a biology course. The science games and science toys developed were evaluated in terms of their scientific creativity, using four criteria: "science knowledge, fluency, flexibility and originality".

Results

Table 1. Evaluating science games / science toys in terms of the four dimensions of scientific creativity

	Very satisfactory	Satisfactory	Unsatisfactory	Very unsatisfactory
Science knowledge	6	12	3	0
Fluency	0	4	12	5
Flexibility	3	12	4	2
Originality	6	5	8	2

Table 1 reports the results of the assessment of science games and science toys designed by pre-service science teachers in terms of the four dimensions of scientific creativity. The data in Table 1 shows that the science games science toys designed were mostly satisfactory in terms of science knowledge, unsatisfactory in terms of fluency, and satisfactory in terms of flexibility. Evaluations in the dimension of originality were mostly evenly distributed, with the unsatisfactory and very satisfactory categories having the largest numbers of items.

Figure1. Samples of Science games and Science toys

Figure 1 presents some of the science games and science toys developed by pre-service science teachers.

Conclusion and Discussion

One of the most effective ways of improving the quality of life and living a higher quality life is to acquire the skill for creative thinking and finding creative solutions to problems (Çelebi Öncü, 2014). Creating a 'novel' product means that its use has 'something different' from earlier products. Innovation is consistent with the 'benefit' or 'value' of creativity. At least theoretically, innovation should offer a solution to some problem (such as lack of a certain product in the market) (Villalba, 2008). The starting point of all innovative approaches is a creative idea (El Bassiti and Ajhoun, 2013).

Learning through games is a learning-oriented field that has recently undergone a process of renovation (Charsky and Ressler, 2011). Science toys offer a captivating and fun way to teach the basic concepts of physics, chemistry and biology. Toys are risk-free designs that generate interest and curiosity, teach scientific concepts embedded in the daily life, develop creativity and problem solving skills, and unearth children's creativity (Amir and Subramaniam, 2005). From another perspective, "Science toys represent an ability to look at toys from a science perspective, and to develop entertaining educational designs using scientific creativity".

Scientific creativity depends upon the steps followed in creating a new product or improving an existing one, that is to say, upon the process of recognizing and solving a problem (Aktamış and Ergin, 2007). Garret (1989) argues that science toys build an environment for creative learning, and toy design requires simultaneous use of science knowledge, technological knowledge and arts/aesthetics (Cited by Amir and Subramaniam, 2005). According to Triona and Klahr, traditional methods can also be used to teach science; these methods typically include assigning books or documents to be read together with lecturing, and involve very little scientific methodology. Alternatively, science can be taught using a hands-on method, allowing students to generate scientific knowledge and to make use of scientific methodology. Development of creative and innovative skills occupies a central place in science education, as these skills allow the development of a strong tie between knowledge and learning; creative learning, in turn, requires innovative teaching (Ferrari, Cachia, and Punie, 2009). Following this line of thought, Demir and Şahin (2013, 2014b) developed science toys with pre-service teachers, and examined the effect of this activity on scientific creativity skills. The present study similarly asked pre-service science teachers to develop science games / science toys, and found that the science games and science toys developed were satisfactory in terms of science knowledge and flexibility and unsatisfactory in

terms of fluency, whereas in terms of originality the distribution of evaluations was more even.

Innovation, technology and design (e.g. of science toys) are all important elements of creativity, and a multidisciplinary approach as well as creative skills is required to create new products and to generate new information (Demir, 2014). In this context, it can be argued that developing creative designs is an important activity for pre-service teachers, and designing science games and science toys can be actively used for teaching purposes, together with creative thinking. This study contributes to the literature by examining pre-service teachers' scientific creativity in practice, and should be followed by further studies on creative design.

References

Aktamış, H., & Ergin, Ö. (2007). Bilimsel süreç becerileri ile bilimsel yaratıcılık arasındaki ilişkinin belirlenmesi. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi (H. U. Journal of Education)*, *33,* 11-23.

Amir, N. and Subramaniam, R. (2005). Fostering creativity in science through ınvention of toys in design & technology laboratories. *The CRPP International Conference on Education* Singapore: The National Institute of Education.

Charsky, D. and Ressler, W. (2011). "Games are made for fun": Lessons on the effects of concept maps in the classroom use of computer games. *Computers & Education, 56*, 604–615.

Demir, S. & Şahin, F. (2013). Fen bilgisi öğretmen adaylarının, hazırlamış oldukları bilimsel oyuncakların bilimsel yaratıcılık açısından değerlendirilmesi. *ULEAD 2013 Annual Congress: International Congress on Research in Education -Multi-paradigmatic Transformative Research in Education: Challenges and Opportunities.* Ürgüp, Nevşehir, Turkey: Nevşehir University.

Demir, S. & Şahin, F. (2014a). Assessment ofopen-ended questions directed to prospective science teachers in terms of scientific creativity. *ERPA 2014. Procedia - Social and Behavioral Sciences*, *152,* 692–697.

Demir, S. & Şahin, F. (2014b). Assessment of prospective science teachers' metacognition and creativity perceptions and scientific toys in terms of scientific creativity. *ERPA 2014. Procedia - Social and Behavioral Sciences, 152,* 686–691.

Demir, S. (2014). *Bilimsel tartışma ve araştırmaya dayalı tasarlanan laboratuvar programının, fen bilgisi öğretmen adaylarının bilimsel yaratıcılıklarına etkisi.* Yayınlanmamış doktora tezi, Marmara Üniversitesi, Eğitimi Bilimleri Enstitüsü, İstanbul.

El Bassiti, L., & Ajhoun, R. (2013). Toward an innovation management framework: A life-cycle model with an idea management focus. *International Journal of Innovation, Management and Technology*, *4(6),* 551-559.

Ferrari, A., Cachia, R., & Punie, Y. (2009). *Innovation and creativity in education and training in the eu member states: fostering creative learning and supporting ınnovative teaching.* Luxembourg: Office for Official Publications of the European Communities.

Hossieni, A., & Khalili, S. (2011). Explanation of creativity in postmodern educational ideas. *Procedia Social and Behavioral Sciences*, *15,* 1307–1313.

Hu, W., & Adey, P. (2002). A scientific creativity test for secondary school students. *International Journal of Science Education, 24(4),* 389-403.

Kanlı, E. (2014). Bilimsel yaratıcılığın çağrışımsal temelleri: Model önerisi. *Türk Üstün Zekâ ve Eğitim Dergisi, 4*(1), 37-50. ISSN 2146-3832.

Kind, P., & Kind, V. (2007). Creativity in science education: Perspectives and challenges for developing school science. *Studies in Science Education*, *43(1),* 1-37.

Villalba, E. (2008). *On creativity; towards an understanding of creativity and its measurements.* İtaly Luxembourg: Office for Official Publications of the European Communities.

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