Eurasian Journal of Educational Research, Issue 58, 2015, 67-88

The Role of Playful Science in Developing Positive Attitudes toward Teaching Science in a Science Teacher Preparation Program

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Suggested Citation:

Bulunuz, M. (2015). The role of playful science in developing positive attitudes toward teaching science in a science teacher preparation program. *Eurasian Journal of Educational Research*, 58, 67-88.
http://dx.doi.org/10.14689/ejer.2014.55.2

Abstract

***Problem Statement*:** Research studies indicate that teachers with negative attitudes toward science tend to use didactic approaches rather than approaches based on students' active participation. However, the reviews of the national academic literature in Turkey located a few research studies on the relationship between playful science experiences and attitudes toward science. This study examines the following components of attitudes: a) enjoyment of learning science and b) interest and motivation toward science, the nature of the classroom environment, and the content of group work.

***Purpose of the Study*:** The purpose of this study was to determine preservice science teachers' attitudes on the roles of playfulness, content of group work, and the class atmosphere after taking a two-semester required science methods course.

***Methods*:** Data were collected by a survey and an open-ended question to examine the role of playful science experiences and positive classroom atmosphere on preservice science teachers' attitudes toward learning and teaching science. Forty-two preservice teachers participated in the study, 18 males and 24 females with an average age of 20. The course was designed to model inquiry-based science teaching, and it focused on discrepant event demonstrations and fun and playful hands-on activities for preservice teachers.

Findings and Results: Preservice teachers' high mean ratings and significant correlations were found on methods course variables. The best

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predictors of developing a positive attitude toward science learning and teaching were *playful activities in the methods course made learning easier* and *playful activities relieved boredom*. These variables explained 43% of the variance. The most frequently mentioned playful/fun activities were making a terrarium, experimenting with mirrors and lenses, examining the effect of air pressure with a balloon in a flask, making a hydrogen balloon, and conducting a science fair project. Preservice teachers' evaluation of the course indicated that interesting hands-on activities, creating concepts real and visible, including novelty activities, and requiring projects that helped with learning to collect and analyze data were the common characteristics of the fun science experiences in the methods course.

Conclusions and Recommendations: This study focuses on the motivational aspects of the science laboratory course in developing positive attitudes toward teaching science through play. Discrepant event demonstrations and exploratory hands-on learning activities that are fun may serve both to capture the interest of the teachers and to model how they can make science activities more playful and engaging for children.

Key Words: Playful science teaching and learning, attitude, positive social environment

According to Piaget (1973, p. 36), "Understanding always means inventing or reinventing, and every time the teacher gives a lesson instead of making the child act, he prevents the child from reinventing the answer." Piaget (1964/2003) proposes that in the construction of knowledge, assimilation is associated with play, whereas accommodation involves adjustment in thinking. According to Vygotsky (1978, p. 102), "In play a child always behaves beyond his average age, above his daily behavior; in play it is as though he were a head taller than himself." Child development theorists think that play, which is a natural way of learning, is necessary for cognitive, social, and personal development. To Severeide and Pizzini (1984), science and play are complementary aspects of problem solving. While science promotes systematic behavior, play promotes creative behavior. Pearce (1999) recommends playful involvement with science in elementary school and notes, "The act of play is in itself an intense scientific study, unassigned and internally motivated" (p. 3). Resnick (2004) employs constructivism in the media lab at MIT in order to create a playful learning environment for children. According to Kean (1998), professional chemists continuously have fun and satisfaction throughout their careers with discoveries regarding how the physical world works. Laszlo (2004) defined science as play with ideas, but not a textbook exercise of learning definitions. He further reported that chemists play games with chemicals like a child who mixes various colors in a paint box to see what comes out. Likewise, chemists ask themselves the question, "What would happen if I change…?" This playful attitude can be extremely fruitful and motivational for scientists and students.

Play is not only for children. "If necessity is the mother of invention, play is the father of discovery" (Gregory, 1997, p. 192). The lives of outstanding scientists including Nobel Prize winners manifest the role of playfulness in scientific pursuits (Fromberg & Bergen, 1998). Play and science are partners in research and invention. The fun and interest arising from playing around with phenomena and experimenting with ideas can bring about positive attitudes toward future learning. In a review of research on interest and learning, Tobias (1994, p. 37) concluded, "Working on interesting, compared to neutral, materials may engage deeper cognitive processing, arouse a wider, more emotional, and more personal associative network, and employ more imagery." According to Ames (1992), views on task motivation experiencing many different types of activities from various science subjects are motivational in that they provide relevance to a range of students in the classroom.

Teachers' enjoyment of science activities may also influence them to teach science in a playful manner. According to Glasser's (1998) choice theory of motivation, having fun is one of the five basic needs of humans. Fun is associated with play: enjoying activities or playing with others. Play is fun, but it is more than that. Its critical dimension is to provide conditions that foster children's development using their own sources of energy (Van Horn, Nourot, Scales, & Alward, 1999). Theorists list the distinguishing features of play as follows: (1) intrinsic motivation, (2) active engagement, (3) attention to means rather than ends, (4) non-literal behavior, and (5) freedom from external rules (Moighan-Nourot, Scales, Van Horn & Almy, 1987). Intrinsic motivation refers to doing an activity for its own sake (e.g., getting involved in activities which are fun, interesting and done without external prods, pressures, or rewards) (Ryan & Deci, 2000). To the contrary, extrinsic motivation refers to performing an activity to reach some separable outcome or doing something for its instrumental value. Intrinsic motivation involves qualities natural to human beings (e.g., being active, inquisitive, curious, playful, ready to learn and explore, and interested in novelty). It can be facilitated or weakened depending on the learning environment, and it arises from interactions between the person and his/her environment.

Teaching through play has become an important pedagogy for teaching and learning. According to Pramling Samuelson's (2006) *Playing-Learning Pedagogy,* the following needs to be ensured both in play and learning: 1) children need to experience first, 2) repetition and variation are naturally used by children in their play and learning, and 3) being aware of children's thinking process and eliciting their thinking through meta-cognitive dialogue and meta-communication are important tools to make their play and learning visible. Therefore, flexibility, possibility, similarity, and variation are important factors in play and learning (Samuelsson & Asplund Carlsson, 2008). The first step of play starts with children's exploration of the materials in their environment (Siraj-Blatchford & MacLead-Brudenell, 2003). While children are acting on materials and changing their environment, they experience the possibilities of play offered in their setting. Marton and Pang (1999, p. 3) defined variation as "different ways of seeing, experiencing, and understanding the same phenomena." Pramling Samuelsson and Asplund Carlsson (2008) stated that variation creates a basis for differentiation, which is critical for both play and learning. They determined that children employ both repetition (the familiar/similar) and variation (abundance/the novel) in their learning goals and their engagement in activities that hold meaning for them. Variation is a teaching strategy where particular knowledge, skills, ideas, and phenomena are made visible to a child. Discernment (noticing things) derives from the experiences of variation, especially as events occur simultaneously and children cannot distinguish a concept or phenomena from others without experiencing variation (Pramling Samuelsson, 2006). As a child thinks in various ways about a topic or phenomenon, s/he becomes able to recognize variations within the topic or phenomenon, and different meanings that may be derived.

Pramling Samuelsson et al., (2001, 2006, 2008) concluded that children use repetition as a learning tool, especially when they are trying to master a physical skill or when they are simply fascinated by a phenomenon. Research studies with preschool children illustrated the importance of variation and repetition, such as the way toddlers naturally employ repetition and variation for learning and playing as they go down a slide, master spinning rings (Lindahl Samuelsson & Pramling Samuelsson, 2002), and learn how to solve problems from experiences with apples (Doverborg & Pramling Samuelsson, 1999). Kanter, Honwad, Adams, and Fernandez (2011) researched the effect of playful learning on middle school students' learning of linear motion and circular motion concepts. They determined that students who had more variations in guided play situations were more attentive, and their reasoning skills in explaining scientific phenomena improved more than students who experienced fewer variations. They also found that a high level of playfulness and attentiveness promoted positive effects on learning science concepts. The authors concluded that a guided play framework can help facilitate students' understanding of complex science concepts while providing fun and engaging experiences.

The above theoretical and research literature on play, learning, and science indicates that having experiences, repetition and variation and metacognitive dialogue and metacommunication with students are important tools for teaching through play. In the context of this study, the principles of teaching through play are applied in three ways. First, many hands-on science concepts were introduced in the methods course. Second, several interesting hands-on activities and discrepant event demonstrations were provided related to each concept throughout their studies. Third, the source of variation was created in an activity by preservice teachers' repetitious participation in the same hands-on activity to explore different aspects of the concept/phenomena by asking questions, making predictions, and experimenting.

Attitudes toward Teaching Science

A positive attitude toward teaching science is an important aspect for the professionalization of teachers in the field of science education (Aalderen-Smeets & van der Molen, 2013; Osborne, 2003). Osborne (2003) described attitudes toward science as, "feelings, beliefs, and values held about an object that may be the enterprise of science, school science, the impact of science on society or scientists themselves" (p. 1053). In the present study, main attention is focused on the components of attitudes such as enjoyment of science learning experiences, perception of the teacher, motivation toward science, the nature of the classroom environment, and development of interest in science-related activities. According to Ajzen and Fishbein, (1980 cited in Osborne, 2003), attitudes toward science and attitudes toward doing school science predict teachers' behaviors about teaching science in the classroom. Osborne (2003) reports that the most significant factor in determining students' attitudes toward science is teachers' attitude toward science (Osborne, 2003). For that reason, it is important that teachers have positive attitudes toward science and teaching science. The availability of a rich, positive, and supportive classroom environment is another important determinant of students' attitudes toward science. Myers and Fouts (1992) found that positive attitudes toward science were associated with students' participation, a supportive social environment, positive relationships with classmates, and the use of a variety of teaching strategies and interesting science activities**.** Woolnough (1991, cited in Osborne, 2003) found that students' positive experiences of extracurricular activities and quality of teaching exhibited in classroom activities were strong influences on their positive attitudes toward science. According to Osborne (2003), the features of good science teaching include being interested and enthusiastic about science, associating lessons with everyday context, and preparing well-ordered and stimulating science lessons. Hidi (2000) added that providing interesting materials or activities is highly effective in the classroom to motivate academically unmotivated students. Studies at junior high school, high school, and university levels show that fun activities and a playful atmosphere enhance learning and positive attitudes (Court, 1993; Palmer, 2004:2009).

Research studies demonstrate that teachers with negative attitudes toward science spend less time teaching it and also employ didactic approaches instead of those based on students' active participation and exploration (Fulp, 2002; Goodrum, Hackling, & Rennie, 2001; Harlen & Holroyd, 1997; Varelas, Plotnick, Wink, Fan, & Harris, 2008; Weiss, 1997). Teacher attitudes toward play and science are crucial. Based on his research study, Wedoe (2001, p. 6) concluded: "To create a valuable play-inspired learning environment the teacher must find this kind of activity enjoyable and meaningful. Only those teachers who are capable of experiencing a certain amount of 'flow' have positive attitudes toward play as an effective teaching method." Modeling theory (Bandura, 1989:1993) would predict that teachers tend to teach science the way they were taught science. Therefore, teacher education programs should revise preservice teachers' poor science learning experiences and help them to feel excited and motivated to teach science through hands-on discovery approaches.

Studies have shown that science methods courses can be very influential in developing positive attitudes (Bulunuz & Jarrett, 2008; Palmer, 2004, 2009; Murphy & Smith, 2012). For example, Murphy and Smith (2012) explored the impact of a year-long science methodology course on second year preservice teachers' attitudes toward teaching science in the primary classroom and found that they held more positive attitudes toward science and the importance of school science after they had taken the course. In another study, Palmer (2004) investigated the sources of situational interest and their effects on the development of positive interest and attitudes toward science. He found that novelty, meaningfulness, and involvement are the main sources of situational interest, and they improved preservice elementary school teachers' attitudes toward science. Palmer (2002) also examined preservice teachers' assignments about observing children at an interactive science center. He found that preservice teachers recognized the importance of hands-on science teaching and the value of making science fun. Examining the relationship between inquiry levels of hands-on science activities and preservice teacher ratings of those activities, Bulunuz, Jarrett and Martin-Hansen (2012) found that activities with higher levels of inquiry were rated higher in interest, fun and learning. Minger and Simpson (2006) found that in an activity-based methods course, preservice teachers' attitudes toward science became more positive.

A literature review based on the Turkish Academic Network and Information Center (ULAKBİM) indicated that attitudes toward science and science teaching were investigated by various studies (Akbaş, 2010; Aydın & Yılmaz, 2010; Erkal, Kılıç, & Şahin, 2012; Bilgin & Geban, 2004; Gündüz & Aslanova, 2012; Köseoğlu & Tümay, 2010; Ören & Tezcan, 2009; Özsoy, 2012). These research studies related the effect of an inquiry learning cycle on students' attitudes toward science in conceptual development (Aydın & Yılmaz, 2010; Köseoğlu & Tümay, 2010; Ören & Tezcan, 2009), the effect of a cooperative learning strategy on preservice elementary teachers' achievements and attitudes toward science (Bilgin & Geban, 2004), the relationship among attitudes toward science teaching, self-efficacy and science process skills (Akbaş, 2010), attitudes toward environment and environmental problems (Erkal, Kılıç, & Şahin, 2012; Gündüz & Aslanova, 2012; Özsoy, 2012).

However, the ULAKBİM review of literature located only a few research studies on the relationship between playful science experiences and attitudes toward science. This study builds on literature that suggests a strong connection between these two components. The present study was designed to determine preservice science teachers' attitudes on the role of playfulness, content of group work, and the class atmosphere after taking a two-semester required science laboratory course. The research questions are:

1) Was the science methods and laboratory class successful in creating a playful and positive classroom learning environment, and if so, what aspects of the course contributed to developing positive attitudes toward teaching science?

2) What are the characteristics of the most playful science experiences in the course?

Methods

Participants

The research was conducted in a two-semester science methods and laboratory course in an elementary science teacher preparation program at a northwestern university in Turkey. The subjects were 42 students: 18 males and 24 females with an average age of 20. Most had taken biology, chemistry, and physics laboratory courses as their science requirements. When taking this course, the students were not in field placements but went to a school and worked with children for their science and play assignments.

Focus of the Science Methods and Laboratory Practice Course

This four-hour course met for 28 weeks. The course focused on hands-on activities, especially exploratory activities, which are fun and playful for children and preservice teachers. A large part of the class time was spent on hands-on activities designed to model the integration of play and science teaching to clarify important concepts and scientific processes and to trigger the interest of preservice teachers. In addition to some demonstrations, students worked cooperatively on open-inquiry hands-on activities, science fair projects, and inquiry modifications of textbook activities for peer teaching and implementation in schools. Hands-on activities and demonstrations were drawn from Bulunuz & Jarrett (2009). The full set of the activities and demonstrations can be found online at http://www.ied.edu.hk/apfslt/

Fun and playfulness in the hands-on science activities were ensured by applying Wassermann's (1998) three-stage Play-Debrief-Replay model and Pramling Samuelsson's (2006) Playing-Learning Pedagogy to the course as instructional methods. First, after providing the necessary environment with equipment and materials, the instructor let the students freely explore the materials to become familiar with them. Second, students reflected on their experiences, and discussed what they observed, what they tried, what they wondered about, and what was surprising. The instructor helped students draw conclusions from their experiences with connections to scientific concepts and principles. Finally, students extended their exploration and replicated earlier discoveries. Therefore, this is not the final stage in scientific inquiry. The students may enter into another play stage in this inquiry cycle. At the beginning of the semester instructors provided a science kit for every student. This kit contained materials such as a compass, magnets, nails, coin, simple electric motor, battery, bulb, wires, droppers, string, paper clips, magnifying glass, and thermometer in a zip-lock bag. The instructor asked students to examine how the materials in the science kit interacted with each other. Students freely explored the materials, and once they were familiar with them, the instructor encouraged students to pose their own question and design their own experiments. The instructor engaged in dialogue with students to learn about their experiences, curiosities and what they discovered. Through this dialogue, the instructor elicited questions and encouraged students to design experiments to test their ideas and discover different aspects of the materials in the science kit. Students' dialogue with the instructor, classmates, and interactions with materials fostered the use of science process skills that involved making predictions, setting up an experimental design in which hypotheses were tested, gathering data, making observations, and examining and evaluating results. For instance, when the instructor put out the science kit most of the students ran the electric motor by connecting it to the battery. Then they repeated the activity making a fan without much new learning. To make the activity playful and exploratory, the instructor stopped by the students' tables and asked the following questions: "Which direction does your electric motor spin? Does it spin the same direction as your friends'? Can you think of a way to change the spinning direction of your electric motor?" In this way, students practiced the application of the left hand rule they were taught in theoretical physics class. The instructor's role is very crucial as a guide (Dewey, 1916) and to provide scaffolding (Vygotsky, 1978) within the student's "zone of proximal development." The hands-on activities were: 1) food chain feeding toad with crickets and insects, 2) building a snail terrarium, 3) exploring optics with a laser and various kinds of lenses and mirrors, 4) making a fountain in a bottle, 5) making a tornado in a bottle, 6) racing jars filled with different amounts of sand on a ramp, 7) making a siphon, 8) making a Cartesian diver, 9) experimenting with water drops on a coin, 10) exploring static electricity, 11) making electric circuits, 12) making paper helicopters, 13) exploring air pressure-linked syringes, 14) relating electricity and magnetism, 15) demonstrating Bernoulli's principle with a ping pong ball and fluorescent tube protector blowing over a strip of paper, blowing under a paper bridge, and blowing on a paper ball in the neck of a bottle, 16) making raisins "dance" in soda, and 17) creating a science project.

Demonstrations were also used as an instructional strategy when materials or time were limited. For demonstrations, Predict-Explain-Observe was used as a teaching technique. First students were asked to make predictions about the situation and phenomena. Second, students were asked to explain the reasoning that supports their predictions. Third, students were engaged in inquiry to test their predictions. When students' observations did not match their predictions, it created a dissonance that led to further investigation. The instructor orchestrated discourse to help students revise their original explanation and develop their conceptual understanding. The demonstrations were: 1) a film canister rocket, 2) warm water boiling in a syringe without heating, 3) a hydrogen balloon, 4) water boiling in a paper cup, 5) air pressure-mysterious hot test tube, 6) air pressure-balloon on the flask, 7) air pressure—inverted glass of water, 8) air pressure—two soda cups on a balloon, 9)Bernoulli's principle- a discrepant funnel, and 10) Bernoulli's principle—leaping ping pong ball. For instance, in the hydrogen balloon activity, the instructor asked students what would happen if we added some pieces of zinc into hydrogen chloride in a flask. After students made predictions, some pieces of zinc were added to the flask, and it was covered with a balloon. When students observed that the balloon was inflating, they were very surprised. The instructor asked students to make predictions about the temperature in the flask. Then the students observed the hydrogen balloon flying in the air and the increased temperature in the flask (exothermic reaction). Next the instructor asked students what would happen if some of the hydrogen was released on a lighter. After students' predictions, a straw was attached to the mouth of balloon and a little hydrogen was released and ignited with a lighter. Making a hydrogen balloon and integrating it with density, flammable and igniter gas concepts in combustion reactions was a real chemistry experience for students. They mindfully participated in the experiment by making predictions, making observations, testing, and explaining their predictions. During the demonstration, students admitted that they had never experienced this before. All security precautions were followed during the experiment, such as wearing goggles, lab coats, etc.

Students also did several assignments throughout the semester. These included: reflections on readings, a science fair project, qualitative analysis of a textbook activity, peer teaching, and implementing lesson activities with children. Students participated in science fair projects in groups. The instructor introduced three types of projects: construction/engineering, experimental/research, and search and find projects. Students were allowed to choose their group and the type of project on which they wished to work. The majority of the groups conducted experimental/ research projects. Examples of these projects included water pollution, waste of heat and water in the faculty education building, the effect of magnetism and battery waste products on plant growth, etc. Only two groups chose construction/engineering projects and search and find projects. Examples for these projects were designing and testing a solar cooker and health diet. In the waste of heat and water projects, the two groups of students determined that there was a huge amount of heat and water wasted in the faculty education building. The findings of these two projects were taken into consideration by the administration, which took some precautionary measures to stop the waste of energy and water in the buildings (e.g., replacing the front door and replacing the leaking urinal faucets). In qualitative analysis of a textbook activity assignment, students chose a cookbook activity from a textbook and adapted it to make it more exploratory and playful for children. After they made modifications to the activity, they implemented it in elementary school classroom.

Data Collection

Playfulness and Science Survey. An eight-statement survey and an open-ended question was developed from Jarrett and Burnley (2010) in order to evaluate participants' views about the role of playfulness and class atmosphere in learning and teaching science. A science educator who has done a research on the role of play and playfulness in the development of interest in science (Jarrett, 1998; Jarrett & Burnley, 2007; Jarrett & Burnley, 2010) reviewed the survey for content validity. The survey was translated into Turkish and administered to the participants.

The unidimensionality of the scale was checked by using explanatory factor analysis in order to calculate the internal consistency coefficient, Alpha. All eight items in the survey loaded on one factor, which indicated the unidimensionality of the survey. The first factor loadings found for six items were as follows: 0.76, 0.75, 0.74, 0.73, 0.56, and 0.47. As it is clear from the factor loadings, each item’s factor loading is greater than the minimum criterion (0.40) (Steven, 2002; Büyüköztürk, 2005). The first factor accounted for 46.34% of the total variance, and the reliability coefficient of the scale was 0.74. This coefficient indicates that the internal consistency of the scale is high. In addition to the survey, the instructor asked participants to respond to the following statement at the end of the semester: "Write down your most playful experiences during the semester and evaluate the role of playfulness, inspiration or "ah-ha" feelings while doing the activities." The purpose of this question was to identify personal experiences participants considered playful in the science methods course. Based on their self-reflections, the common characteristics of the playful science activities in the course were described.

Results

Was the science laboratory class successful in creating a playful and positive classroom learning environment, and if so, what aspects of the course contribute to developing positive attitudes toward teaching science?

Descriptive statistics were calculated on the seven survey statements answered at the end of the course in order to examine the effect of the course on students' perceptions about the class atmosphere and playfulness. Each was scored on a 1 to 5 scale in which 5 was the most positive. Table 1 provides means and standard deviations of student ratings on the roles of playfulness, class atmosphere, and content of class group work in learning science.

Table 1.

Descriptive Statistics for Relevant Aspects of the Course

Role of play in learning science	**N**	**Mean**	**S.D**
1. In science class, playful activities made learning easier	42	4.60	.59
2. Playful/fun activities increased my interest in learning science concepts.	42	4.60	.50
3. Playful activities helped me to develop a positive attitude toward science learning and teaching.	42	4.50	.59
Class atmosphere and content of class group work			
4. Playful activities relieved boredom.	42	4.67	.53
5. Interesting science phenomena and concepts were provided in science class.	42	4.14	.65
6. Supportive social environment and positive classroom atmosphere were provided.	42	4.42	.63

In order to determine relationships between interest in learning science and content of the class activities with group work, a correlation matrix was computed. The following matrix indicates that several of the above variables are inter-correlated, in particular, the variables concerning the role of play in learning science.

Table 2.

Intercorrelations Between the Role of Play and the Class Atmosphere and Content of Class Group Work *Variables in Learning Science*

	1	2	3	4	5
1. Playful activities made learning easier.	-				
2. Playful/fun activities increased interest.	.56***	-			
3. Playful activities developed positive attitude toward science learning and teaching.	.59***	.41**	-		
4. Playful activities relieved boredom.	.34*	.46**	.47**	-	
5. Interesting science phenomena/concepts were provided.	.41**	n.s.	n.s.	n.s.	-
6. A supportive social environment and positive classroom atmosphere were provided.	n.s.	n.s.	n.s.	ns	.32*

*p<.05, **p<.01, ***p<.001

Intercorrelations in the role of playfulness and class atmosphere variables indicated that an increase in *developing positive attitude toward learning and teaching science* was significantly correlated with *playful activities made learning easier* (r=.59, p<.001), *playful and fun activities increased interest (r=.41, p<.001), and playful activities relieved boredom (r=.47, p<.001).*

To determine which aspects of the course contributed to developing positive attitudes toward learning and teaching science, a step-wise multiple regression was computed. In the selection of independent variables, the role of play in learning science and class atmosphere and the content of class group work variables that were significantly correlated with the dependent variables were put into the regression analyses. The resulting step-wise regression analyses for *playful activities developed positive attitude toward science learning and teaching* are summarized in Table 3.

Table 3.

Regression Analysis for Preservice Teachers' Attitude toward Learning and Teaching Science

Variable	*B*	*SE B*	β
Playful activities made learning easier.	.49	.13	.49**
Playful activities relieved boredom.	.34	.14	.30*

p* <.05; p** < .001; Note: R = .65; R^2 = .43

The regression analysis found that *playful activities made learning easier* and *playful activities relieved boredom* was significantly associated with *attitude toward learning and teaching science*. These variables explained 43% of the variance. The best predictor of developing positive attitude toward science learning and teaching was *playful activities in the methods course made learning easier* followed by *playful activities relieved boredom*.

What are the characteristics of most playful/fun science experiences in the course?

In response to the open-ended question in which students were asked to write the most playful experiences they had during the semester and to evaluate the role of playfulness, inspiration, or "ah-ha" feelings while they were doing the activities, students mentioned 43 different "most playful" activities. The most frequently mentioned were making a terrarium (23%), experimenting with mirrors and lenses (16%), examining the effect of air pressure with a balloon in a flask (12%), making a hydrogen balloon (9%), and creating a science fair project (5%). Two students wrote general comments about the course, and the role of playfulness, inspiration, or "ah-ha" feelings while they were doing the activities. According to the reflection below, the common characteristics of the class activities were being fun, playful and motivational. This reflection indicates the initiating interest by providing surprising or novel activities at the beginning of the lesson was crucial to maintaining motivation throughout the lesson.

"I was interested in most of the activities we did in the class. I could not choose just one experiment, since I could not remember all the activities we did. However, I am sure this course was very different and went well. I do not remember if I was ever bored, and most of the time I did not realize that the lesson had gone by so fast. To me these are the number one efficient factors for learning. The interest in the course and in preparing kids for learning can be achieved by things that are exciting and intriguing. The first phase of learning is more important than the middle or final phase. Getting students to focus on the lesson at the beginning is very crucial to their learning. This can be done by providing exciting, surprising, and interesting things. I think the first phase of the lesson is more important than the final and middle phases. When a student's focus is captured at the beginning of the lesson, the task is done. When the students' receivers are open, there is no need to do more things. This happens with things that arouse students' excitement, surprise, wonder and enjoyment."

Of the activities mentioned, 23% (10 out of 43) referred to building a terrarium for a toad and observing the food chain by feeding the toad various insects. The popularity of the terrarium and food chain activity indicates that having real life experiences are very interesting and important for student learning. One student wrote:

"Making a terrarium was the most interesting activity in this semester. We got a chance to observe live images and knowledge that we memorized from biology textbooks or watched on a documentary."

Seven students (16%) referred to optical activities with mirrors, lenses, and lasers. In these hands-on learning activities, students played with various types of lenses, mirrors and laser pointers to direct the light in certain directions. The characteristic of this activity was that making phenomena visible to students was important for long-lasting learning. One student stated, *"This was the first time the knowledge I had learned for years became visible. These were noteworthy and long-lasting learning activities."* Five students (12%) wrote about discrepant events about atmospheric pressure. One remarked, *"The balloon going into the Erlenmeyer flask when it cooled was surprising. It was permanent learning about atmospheric pressure. Surprising and interesting experiments increase students' participation and learning."* Four students (9%) wrote about making a hydrogen balloon by mixing zinc and hydrochloric acid. For example, one student stated, "*To observe reactions was interesting and a very good example. In addition to this, it was also possible to see density differences and the flammability of hydrogen.*" The common characteristics of the two discrepant event demonstrations were: being new, unusual, or not knowing what was going to happen (suspense) or something unexpected happening (surprise). Two participants (5%) mentioned their science fair project. One said, "*I enjoyed my science project most. I learned research skills, such as collecting and analyzing data in my project. For this reason, I liked my project very much.*" Based on students' reflections, the characteristics of the science fair project were that they were enjoyable and that they experienced a scientific process and research skills. Two students wrote general, positive comments about the course and stated that the course increased their interest. For example, one wrote, "*This was the first time we got rid of monotonous things in learning science. Learning new things increased my interest in learning science*." This general comment indicates that the novelty of hands-on activities and demonstrations are important factors in promoting interest in science.

Discussion and Conclusions

The course included various inquiry hands-on science activities and discrepant event demonstrations in which preservice teachers were encouraged to investigate different aspects of science concepts through a playful learning approach. Finding high mean ratings on methods course variables suggests that playful/fun involvement and enjoyment with the course activities were important features of the science methods course to develop positive attitudes toward teaching science. The participants' positive evaluation of the role of play in learning science, class atmosphere, and content of group work suggests that the playful experiences in the methods course had a major effect in developing positive attitudes toward science and science teaching. This supports intrinsic motivation theory (Ryan & Deci, 2000), and choice theory of motivation (Glasser, 1998) that doing or engaging in activities that are fun, engaging and interesting motivates people without external rewards or pressures (Hidi, 2000; Tobias, 1994; Ames, 1992).

High intercorrelations among ratings of the methods course variables such as *playful activities made learning easier, playful activities promote interest, relieved boredom, interesting phenomenon and concepts provided in the class* suggest that these dimensions tend to vary and influence or promote each other. This finding is consistent with other research studies findings that show that positive attitudes toward science relates to students' participation, a supportive social environment, a positive relationship with classmates, and the use of variety teaching strategies with interesting activities (Bulunuz & Jarrett, 2008; Hidi, 2000; Jarrett &Burnley, 2010; Kanter, Honwad, Adams, and Fernandez, 2011; Myers & Fouts, 1992; Osborne, 2003; Palmer, 1999:2009). In the present study, experiencing fun and playfulness in the methods course could have promoted students' attitudes and enjoyment from the class. Experimenting with several science activities related to different content that they had not previously experienced might have promoted positive attitudes toward science. Likewise, the provision of interesting material might have increased the sense of enjoyment and attitudes toward teaching science. The study demonstrated that playfulness in the course was linked to making learning easier, providing fun and interesting phenomena, generating a supportive social environment, and creating a positive classroom atmosphere. This finding demonstrated that preservice teachers' attitudes toward teaching science can be improved by providing interesting and playful experiences in a positive and supportive classroom atmosphere. In this environment, preservice teachers should be able to explore their "wonderings," curiosity, and questions. Activities should provide students with an opportunity to experience a sense of playfulness and excitement. The classroom atmosphere should be positive, friendly, and supportive, and it should create a learning environment where participants can engage actively with scientific phenomena and discuss their understandings with friends and instructors. The best predictors of attitude toward teaching science were playful activities in the methods course that made learning easier and the playful activities that relieved boredom. The finding that playfulness made learning easier and playful activities relieved boredom in the methods course predicted attitude toward science teaching supports the view that playful involvement with science (Laszlo, 2004; Minger & Simpson, 2006; Piaget, 1964/2003; Pearce, 1999; Resnick, 2004; Wedoe, 2001) is a salient motivator for learning and teaching science. Fun and playful science experiences can be critical in breaking the unproductive cycle in science education in which teachers who do not enjoy science predispose the next generation to not enjoy science. In order to enhance preservice teachers' attitudes toward teaching science, science methods courses need to include ways to motivate students, especially those with negative previous science experiences and attitudes toward science. Experiencing fun, playful, interesting activities in a positive and supportive social environment were important variables for developing preservice science teachers' attitudes toward teaching science.

Finding that playful activities made learning easier was the best predictor of interest in teaching science implies that a science methods course should provide a playful and risk-free learning environment.

The results of students' self-reflections indicated that the most common characteristics of playful/fun science experiences in the course were: 1) providing interesting or surprising activities at the beginning of the lesson; 2) having live or real-life experience with biology; 3) making concept or phenomena visible; 4) experiencing new, unusual, or unexpected events; and 4) learning research project skills. The result of the survey also confirmed that the course did contain playful experiences for preservice teachers. It can be concluded that sustained playful experiences can develop good attitudes toward science teaching. The playful/fun hands-on activities in this course not only improved attitudes toward science teaching, but also modeled many practical ideas and examples on how to make lessons fun and playful in the classroom with materials that are inexpensive and readily found in children's environments. The material in the class, designed to be fun while clarifying difficult science topics and making learning interesting, was successful. Experiencing inquiry learning through playful experiences to develop positive attitudes toward teaching science supports the premise of Bandura's (1989, 1993) modeling theory that indicates that learning occurs by observing modeled behavior. The course attempted to model ways in which preservice teachers can teach science to their future classrooms. Teaching science through playful, interesting and fun activities in a supportive social environment has an important potential to improve attitudes for learning and teaching science. These preservice teachers are likely to be better science teachers than their teachers were, because these students obviously learned to enjoy "swimming in science."

This study relied on surveys to evaluate playfulness in the methods course and their contribution to participants' developing attitudes toward teaching science. In order to better understand the meaning of survey results, focus groups or individual interviews could be employed to better interpret participants' ratings. Further research should include data collection tools, such as observations in field placements, interviews with preservice and mentor teachers, analysis of lesson plans, reflections, and children's work.

References

Akbaş, A. (2010). Attitudes, self-efficacy and science processing skills of teaching

certificate master's program (ofmae) students. *Eurasian Journal of Educational Research, 39*, 1-12.

Aalderen-Smeets, van, S.I., & Walma van der Molen, J.H., (2013). Investigating and stimulating primary teachers' attitudes towards science: Summary of a large-scale research project. *Frontline Learning Research*, *1*(2), 3-11.

Ames, C. (1992). Classrooms: goals, structures, and student motivation. *Journal of Educational Psychology, 84* (3), 261-271.

Aydın, N., & Yılmaz, A. (2010). The effect of constructivist approach in chemistry Education on students' higher order cognitive skills. *Hacettepe University Education Faculty Journal, (39),* 57-68.

Bandura, A. (1989). Human agency in social cognitive theory. *American Psychologist, 28* (2), 117-148.

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist, 28* (2), 117-148.

Bilgin, İ., & Geban, Ö.(2004). Investigating the effects of cooperative learning strategy and gender on preservice elementary teacher students' attitude toward science and achievement of science teaching class I, *Hacettepe University Education Faculty Journal, (26)*, 9-18.

Bulunuz, M., & Jarrett, O. S. (2008). Development of positive interest and attitudes toward science and interest in teaching elementary science: influence of inquiry methods course experiences. Paper was presented at the Teacher Education Policy in Europe (TEPE), University of Ljubljana, Slovenia.

Bulunuz, M., & Jarrett, O. S. (2009). Undergraduate and masters students' understanding about properties of air and the forms of reasoning used to explain air phenomena. *Asia-Pacific Forum on Science Learning and Teaching, 10* (2), 1-20.

Bulunuz, M., Jarrett, O. S., & Martin-Hansen, L. (2012). Level of inquiry as motivator in an inquiry methods course for preservice elementary teachers. *School Science and Mathematics*, *112* (6), 330-339.

Büyüköztürk, Ş. (2005). *Sosyal bilimler için veri analizi el kitabı*, Ankara: Pegem Yayıncılık.

Court, D. (1993). A playful environment in a cooperative physics classroom. *Clearing House, 66* (5), 295-299.

Dewey, J. (1916). *Democracy and Education: an introduction to the philosophy of education*. New York: The Free Press.

Doverborg, E., & Pramling Samuelsson, I. (1999). Apple cutting and creativity as a mathematical beginning. *Kindergarten Education: Theory, Research and Practice, 4* (2), 87-103.

Erkal, S., Kılıç, İ., & Şahin, H. (2012). Comparison of environmental attitudes of university students determined via the new environmental paradigm scale according to the students' personal characteristics. *Eurasian Journal of Educational Research, 49*, 21-40.

Fromberg, D. P., & Bergen, D. (1998). *Play from birth to twelve and beyond: Contexts, perspectives, and meanings.* New York: Garland Publishing, Inc.

Fulp, S. (2002). The status of elementary science teaching: National survey of science and mathematics education. Chapel Hill, NC: Horizon Research, Inc. Retrieved December 20, 2005 from, http://2000survey.horizon-research.com/reports/elem_science.php.

Glasser, W. (1998). *Choice Theory: A new psychology of personal freedom*. New York: Harper Perennial.

Goodrum, D., Hackling, M., & Rennie, L. (2001). *The status and quality of science teaching and learning of science in Australian schools. A research report* (Canberra: Department of Education, Training and Youth Affairs).

Gregory, R. (1997). Science through play. In R. Levinson & J. Thomas (Eds.), *Science today: Problem or crisis?* (pp. 192-205). London: Routledge.

Gündüz, Ş., & Aslanova, F. (2012). Usage of knowledge management tools: Determination of the knowledge levels and attitudes of Azerbaijani university students about environmental issues educating in Azerbaijan and TRNC. *Eurasian Journal of Educational Research,* 49/A, 349-368.

Harlen, W., & Holroyd, C. (1997). Primary teachers' understanding of concepts of science: Impact on confidence and teaching. *International Journal of Science Education, 19*, 93–105.

Hidi, S. (2000). Motivating the academically unmotivated. *Review of Educational Research*, *7*, 151–179.

Jarrett, O. S. (1998). Playfulness: A motivator in elementary science teacher preparation. *School Science and Mathematics*, *98*(4), 181–187.

Jarrett, O. S., & Burnley, P. (2007). The role of fun, playfulness, and creativity in science: Lessons from geoscientists. In D. Sluss and O. Jarrett (Eds). *Investigating play in the 21st Century: Play and Culture Studies, Vol. 7*. Lanham, MD: University Press.

Jarrett, O. S., & Burnley, P. (2010). Lessons on the role of fun/playfulness from a geology undergraduate summer program. *Journal of Geoscience Education, 58* (2), 213-220.

Kanter, D., Honwad, S., Adams, J.D., & Fernandez, A. (2011). Guiding Play for Science Learning in Middle School. *Children, Youth, and Environment, 21* (2), 360-382.

Kean, E. (1998). Chemist and play. In D.P. Fromberg & D. Bergen (Eds.), *Play from birth to twelve and beyond: Context, perspectives, and meanings.* (pp. 468-472). New York: Garland Publishing.

Köseoğlu, F., & Tümay, H. (2010). The effects of learning cycle method in general chemistry laboratory on students' conceptual change, attitude and perception. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi, 11* (1), 279-295.

Laszlo, P. (2004) Science as play. *American Scientist*, September-October. Retrieved January 23, 2005 from, http://www.americanscientist.org/template/AsetDetail/assetid/.

Lindahl, M., & Pramling Samuelsson, I. (2002). Imitation and variation: reflections on toddlers' strategies for learning. *Scandinavian Journal of Educational Research. 46* (1), 25-45.

Marton, F., & Pang, M. F. (1999). Two faces of variation. Paper presented at 8th European Conference for Learning and Instruction, Göteborg, Sweden.

Minger, M.A., & Simpson, P. (2006) The impact of a standards-based science course for preservice elementary teachers on teacher attitudes toward science teaching. *Journal of Elementary Science Education, 18* (2) 49-61.

Monighan-Nourot, P., Scales, B., Van Hoorn, J., & Almy, M. (1987). *Looking at children's play: A bridge between theory and practice.* New York: Teachers College Press.

Murphy, C., & Smith, G. (2012). The impact of a curriculum course on preservice primary teachers' science content knowledge and attitudes towards teaching science. *Irish Educational Studies, 31*(1), 77-95.

Myers, R. E., & Fouts, J. T. (1992). A cluster analysis of high school science classroom environments and attitude toward science. *Journal of Research in Science Teaching*, *29*, 929–937.

Osborne, J. (2003). Attitudes towards science: A review of the literature and its implications. *International Journal of Science Education, 25* (9), 1049-1079.

Ören, Ş. F., & Tezcan, R. (2009). The effectiveness of the learning cycle approach on learners' attitude toward science in seventh grade science classes of elementary school. *Elementary Education Online, 8* (1), 101-113.

Özsoy, S. (2012). A survey of Turkish pre-service science teachers' attitudes toward the environment. *Eurasian Journal of Educational Research, 46*, 121-140.

Palmer, D. (1999). Students' perceptions of high quality science teaching. *Australian Science Teachers Journal, 45* (3), 41-45.

Palmer, D. (2002). Preservice elementary teachers' perceptions after visiting an interactive science center. *An Online Journal for Teacher Research, 5*(3), 1-6.

Palmer, D. (2004). Situational interest and the attitudes towards science of primary teacher education students. *International Journal of Science Education, 26*(7), 895-908.

Palmer, D. (2009). Student interest generated during an inquiry skills lesson. *Journal of Research in Science Teaching, 46* (2), 147-165.

Pearce, C.R. (1999). *Nurturing inquiry: real science for the elementary classroom.* Portsmouth, NH: Heinemann.

Piaget, J. (1964/2003). Development and Learning. *Journal of Research in Science Teaching, 40*, Supplement. 8-18 (Original work published in 1964).

Piaget, J. (1973). *How a child's mind grows*. In M. Miller, The neglected years: Early Childhood (pp. 24-36). New York: United Nations Children's Fund.

Pramling, N., & Pramling Samuelsson, I. (2001). "It is floating 'cause there is a hole:" A young child's experience of natural science. *Early Years, 21* (2), 139-149.

Pramling Samuelsson, I., & Asplund Carlsson, M. (2008). The playing learning child. Towards a pedagogy of early childhood. *Scandinavian Journal of Educational Research, 52* (6), 623-641.

Pramling Samuelsson, I. (2006). Teaching and learning in preschool and the first years of elementary school in Sweden. In J. Einarsdottir & T. J. Wagner (Eds.), *Nordic early childhood education. International Perspectives on Educational Policy, Research and Practice in Denmark, Finland, Iceland, Norway, and Seweeden.* (pp. 101-131). Greenwich: Information Age Publishing.

Resnick, M. (2004). Edutainment? No thanks. I prefer playful learning. Retrieved August 12, 2002 from, http://llk.media.mit.edu/papers/abc.html.

Ryan, R. M., & Deci, E.L. (2000). Intrinsic and extrinsic: classic definitions and new directions. *Contemporary Educational Psychology, 25*, 54-67.

Severeide, C.R., & Pizzini, L.E. (1984). The role of play in science. *Science and Children, 21*(8), 58-61.

Siraj-Blatchford. J., & MacLead-Brudenell, I. (2003). *Supporting science design and technology in early years.* Buckingham: Open University Press.

Stevens, J. P. (2002). *Applied multivariate statistics for the social sciences*, Mahwah, New Jersey: Lawrence Erlbaum Associates.

Tobias, S. (1994). Interest, prior knowledge, and learning. *Review of Educational Research, 64* (1), 37-54.

Varelas, M., Plotnick, R., Wink, D., Fan, Q., & Harris, Y. (2008). Inquiry and connections in integrated science content courses for elementary education majors. *Journal of College Science Teaching*, 37 (5), 40-45.

Van Aalderen-Smeets, S.I., & Walma van der Molen, J.H. (2013). Measuring Primary Teachers' Attitudes Toward Teaching Science: Development of the Dimensions of Attitude Toward Science (DAS) Instrument, *International Journal of Science Education, 35*(4), 577-600.

Van Horn, J. L., Nourot, P. M., Scales, B.R., &. Alward. K. R. (1999). *Play at the Center of the Curriculum* (p. 4) New Jersey : Merrill Prentice Hall.

Vygotsky, L. S. (1978). *Mind in Society*. Cambridge, MA: Harvard University Press.

Wassermann, S. (1998). Teaching Strategies. Play-debrief-replay: an instructional model for science. *Childhood Education, 64* (4), 232-34.

Wedoe, L. (2001). Science and play - oil and water? Paper presented at the International Council for Children's Play, Erfurt.

Weiss, R. I. (1997). *The status of science and mathematics teaching in the US: Comparing teacher views and classroom practices to national standards.* National Institute for Science Education (NISE Brief), 1 (3).

Fen Bilgisi Öğretmeni Yetiştirme Programında Oyunla Bütünleştirilmiş Fen Derslerinin Fen Öğretimine Karşı Olumlu Tutum Geliştirmedeki Rolünün Değerlendirilmesi

Atıf:

Bulunuz, M. (2015). The role of playful science in developing positive attitudes toward teaching science in a science teacher preparation program. *Eurasian Journal of Educational Research*, 58, 67-88.
http://dx.doi.org/10.14689/ejer.2014.55.2

Özet

***Problem Durumu*:** Yapılan araştırmalar fen bilimlerine karşı negatif tutumu olan öğretmenlerin bu derse daha az zaman ayırdığını, öğrencilerin ders içi etkinliklere katılımına ve keşfetmelerine dayanan dersler yerine düz anlatım yolunu seçtiklerini göstermektedir. Yurtdışında yapılan araştırmalar, oyun aracılığıyla gerçekleştirilen etkinliklerin hem öğretmenin hem de öğrencilerin fen bilgisine karşı tutumlarını olumlu yönde geliştirdiğini ortaya koymaktadır. Ancak yapılan alanyazın taramasında, ülkemizde oyunla bütünleştirilmiş fen bilgisi öğretimi/öğrenimi ile öğretmen ya da öğretmen adaylarının tutumları arasındaki ilişkiyi araştıran çalışmalara rastlanamamıştır. Bu çalışmada, tutumun fen öğrenimi ve öğretimi deneyimlerinden duyulan mutluluk, öğretmen algısı, derse dair motivasyon, sınıf ortamının özellikleri ve gerçekleştirilen etkinlikler konu edilmiştir.

***Araştırmanın Amacı*:** Bu çalışmada oyun yoluyla yapılan fen bilgisi etkinlikleri, grup çalışmaları ve pozitif sınıf atmosferinin öğretmen adaylarının fen öğrenme ve öğretmeye karşı tutumlarıyla olan ilişkisi incelenmiştir.

Araştırmanın Yöntemi: Oyun yoluyla gerçekleştirilen fen bilgisi etkinliklerinin, pozitif sınıf atmosferinin öğretmen adaylarının fen öğrenme ve öğretim tutumları arasındaki ilişki ele alınmıştır. Veri toplama aracı olarak anket ve açık uçlu bir soru kullanılmıştır. Çalışma, bahar ve güz yarıyılında okutulan Fen Bilgisi Öğretimi ve Laboratuar Uygulamaları I ve II dersinde gerçekleştirilmiştir. Araştırmaya yaş ortalamaları 20 civarında 18 erkek, 24 kız toplam 42 öğretmen adayı katılmıştır. Söz konusu derslerde araştırma ve oyun yoluyla fen öğretimi yaklaşımı esas alınmıştır.

Araştırmanın Bulguları: Öğretmen adaylarının ankete vermiş oldukları puanlar, fen öğretimi dersi ile ilgili değişkenlerin ortalamalarının oldukça yüksek ve bu değişkenler arasında anlamlı bir ilişki olduğunu göstermiştir. Fen bilgisi öğrenimi ve öğretimine karşı olumlu tutum geliştirmeyi en çok belirleyen değişkenlerin oyun yoluyla işlenen etkinliklerinin fen öğrenmeyi kolaylaştırması ve bu etkinliklerin dersi sıkıcı olmaktan kurtarması olduğu belirlenmiştir. Bu değişkenlerin *genel tutumun* %43'ne denk geldiği saptanmıştır. Öğretmen adaylarınca en çok eğlenceli ve oyun içeren etkinliğin a) kara kurbağası için *teraryum* yapma ve besin zincirini gözlemek için onu böceklerle besleme, b) çeşitli aynalar ve merceklerle deneyler yapma, c) atmosfer basıncının *Erlenmayer* üzerindeki balona basıncını keşfetme, d) hidrojen

balonu yapma ve balondaki gazın yanıcı özelliği ile ilgili deneyler yapma ve e) araştırma projesi yapmak olmuştur. Öğrencilerin yapmış olduğu değerlendirmelere göre derste oyun gibi ve eğlenceli bulunan deneylerin ortak özellikleri şunlardır: 1) ilginç ve süpriz etkinliklerin derste işlenmesi, 2) biyoloji ile ilgili gerçek hayattan deneyimlerin deneyimlerin derste yaşatılması, 3) derste işlenen kavram ya da doğal olayların görselleştirilebilmesi, 4) deneylerde yeni, sıradışı, ve beklenmedik şeylerin yaşanması, 5) araştırma becerilerinin öğrenilmesi.

Araştırmanın Sonuçları ve Öneriler: Bu çalışmada fen öğrenimi ve öğretimine karşı pozitif tutum geliştirmede, oyun yoluyla fen öğretiminin motivasyon içeren özellikleri vurgulanmıştır. Yaparak-yaşayarak fen öğretiminde özellikle keşfederek yapılan etkinliklerin eğlenceli ve oyun içermesi, öğretmenin ilgisini çekmesinin yanı sıra, onlara fen etkinliklerini çocuklar için nasıl daha fazla oyun içerecek şekilde işlemeleri, ilgi çekici hale getirmeleri ve daha verimli kılma konularında model almalarını sağlayacak deneyimler sunmaktadır. Bu çalışmanın sonuçları fen öğretiminde ilgi ve tutum geliştirmek için, fen derslerinde birçok ilgi uyandıran farklı etkinliklerin gerçekleştirilmesinin yanı sıra, yapılan etkinliklerin oyun ile bütünleştirilerek öğrencileri araştırma ve keşfetmeye cesaretlendirecek sınıf ortamlarının düzenlenmesini önermektedir.

Anahtar Sözcükler: Oyun yoluyla fen öğretimi, pozitif sınıf ortamı, tutum, fen bilgisi öğretimi.