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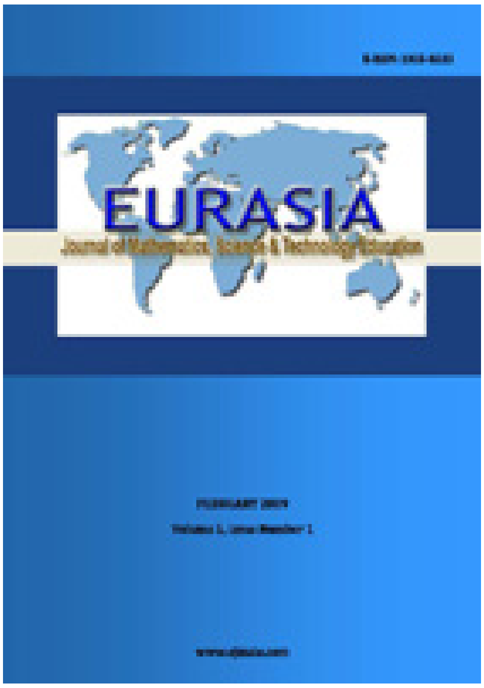

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The purpose of this research, conducted in a science methods course in Turkey, was to explore the qualities of hands-on science activities which might motivate preservice kindergarten teachers to use these activities in their own classrooms. Two similar classes totaling 47 students and taught by the same instructor were used in this study. On surveys filled out at the end of the course, students rated course activities as fun, interesting, and high in learning and identified which activities they were likely to use in their own classrooms. Results indicated that student ratings of activities as fun, interesting, and high in learning were highly correlated and that students rated the activities they expected to use in the classroom significantly higher in fun, interest, and learning than the activities they did not intend to use. Implications for teaching science methods courses are discussed.

Keywords: Motivation, hands-on science, kindergarten science education

INTRODUCTION

Current reform movements in the U.S. and in Turkey recommend that science classes be taught by inquiry methods, focusing not just on the knowledge of scientific facts, laws, theories but also concern for developing inquiry skills and understanding the nature of scientific inquiry (National Research Council (NRC), 1996, Milli Eğitim Bakanlığı (MEB, 2006). Sabar (1979, p. 262) suggests that science curriculum include "the learner population's relevant interest and concerns about coping in this world." Lowery, (1997, p. 35) states, "when we teach science as inquiry we need to shift from a dependence on textbooks as the basic source of information to using texts and books as references." Inquiry methods represent the investigative nature of science, as learners satisfy their curiosity and activly search for knowledge. Inquiry reflects the consructivist model of learning (Tobin, 1993) and involves hands-on instruction, allowing the learners to be active and independent, acquiring knowledge on their own. According to Turkmen and Bonnstetter (1998, p. 18), the main emphasis in lower primary school (K-5) "should be on building the children's curiosity and problem-solving skills by doing very simple hands-on science projects." They also recommend that in upper primary school (6-8) students spend considerable time on group projects coming from students' natural curiosity and questions. Ünal and Akman (2006) stated that early childhood teachers' attitudes toward science education and the activities they prepared for chidren are very important for developing children's thinking and science process skills.

Unfortunately, both in Turkey (Turkmen & Bonnstetter, 1998) and in the U.S. (Fulp, 2002; Silversten, 1993; Weiss, 1994), teachers tend not to provide recommended inquiry experiences for their students. Many teachers avoid inquiry science because their own school science experience was negative. Jarrett (1999) and Bulunuz & Jarrett (2009) found that the quality of preservice teachers' own elementary school science experience was a strong predictor of whether or not they were interested in science as adults. Hawkins (1990, p. 97) calls this "a loop in history, by which some children grow to be teachers: taught science

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State of the literature

- Whether teachers enjoy science activities in a playful way may also influence whether they decide to teach in the same manner.
- The quality of preservice teachers' science experience important factor on their development of interest in learning and motivation for teaching science.
- Working on fun, interesting, and playful materials engage deeper cognitive processing, arouse a wider, more emotional, and more personal associative network, and motivation in learning and teaching science.

Contribution of this paper to the literature

- Finding positive relationship between fun, interest, and learning suggests that qualities of activities in method courses may significantly influence teachers' enjoyment and promote engagement with science.
- Motivation to do specific hands-on activities in the classroom was highly related to the fun, interest, and learning value of the activity for the teacher. The higher ranked activities tended to be exploratory in nature, enabling the preservice teachers to experience something new in nonthreatening way.
- Student teachers especially liked variety of hands-on activities and resources available in their environment. This finding suggests that science activities should be interesting and suitable for kindergarten science education.

little and poorly, they teach little and poorly." To break this unproductive cycle, teacher preparation programs must provide hands-on experiences that promote positive attitudes and values toward science (Marcuccio & Marshall, 1993) and model the way teachers are encouraged to teach (Glass, Aiuto, & Andersen, 1993).

Teachers who believe that science is serious, boring, and difficult are not likely to involve their students in the fun/playfulness of scientific inquiry that is especially important for young children. Whether teachers find science activities interesting may be important to their decision to implement those activities in the classroom. Piaget (1969/70, p. 158-159) stated, "True interest appears when the self identifies itself with ideas or objects, when it finds in them a means of expression and they become a necessary form of fuel for its activity." This "law of interest"... "controls the intellectual functioning" of both children and adults (p. 159). Research on interest suggests that: (a) interest motivates behavior (Deci, 1992), (b) interest is an enduring "disposition" (Krapp, Hidi, & Renninger 7), and "interest is a phenomenon that emerges from an individual's interaction with his or her environment" (Krapp et al., 1992, p, p. 5).

According to Stepans, Shiflett, Yager, and Saigo (2001), professional development experiences that simply talk about other ways to teach, or that focus on demonstrations or specialized laboratory activities, may miss the point that teachers, like students, need concrete, connected experiences to build knowledge, understanding, and ability. Teachers need direct experiences that put them again in the role of learners, taking risks to experience conceptual change. Examples drawn from science methods classes (Beiswenger, Stepans, & McClurg, 1998; Bulunuz, Jarrett, & Martin-Hansen, in press 2012; Keating & Ihara, 1997/1998) and professional development programs (Galloway, 2000; Stepans, et al., 2001) suggest that allowing students to design their own experiments can have powerful effects on interest and motivation. According to Stukus and Lennox (1995), students who design their own experiments report having a heightened sense of ownership, which in turn increases their motivation and interest in science.

In a review of research on interest and learning, Tobias (1994, p. 37) concluded that "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." Palmer's research (2004; 2009) investigated the effect of hands-on activities and discrepant event demonstrations on the development of positive attitudes toward science. He found that novelty is the main source of interest in hands-on science activities and these activities improved preservice elementary school teachers' attitudes towards science.

Bulunuz and Jarrett (2008) examined the effect of fun and playful hands on activities on preservice elementary teachers' interest and attitudes in science teaching. They found that playful and interesting hands-on activities increased preserevice elementary teachers' interest in science and attitudes toward teaching science. According to play theorists, the distinguishing features of play include: (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 Hoorn & Almy, 1987). Whether teachers enjoy science activities in a playful way may also influence whether they decide to teach in the same 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 fun. Its critical dimension is to provide conditions that foster children's development using their own sources of energy (Horn & Scales, 1999). Early childhood educators have observed and emphasized that young children bring an energy and enthusiasm to their play that not only seems to drive development but also seems to be an inseparable part of development. A kindergarten student building with blocks might spend an hour focused intently on this task, but might squirm when asked to sit down for ten minutes to practice writing letters of the alphabet (Moighan-Nourot et al., 1987). According to Vygotsky, play creates zone of proximal development which is essential to development. "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" (1978, p.102).

Play is not only for children. "If necessity is the mother of invention, play is the father of discovery" (Gregory, 1997, p. 192).The role of playfulness in scientific pursuit is seen in the lives of eminent scientists, including Nobel Prize winners (Fromberg & Bergen, 1998). Play and science are partners in research and invention. The fun and interest that come from playing around with phenomena can set positive attitudes toward future learning. According to Kean (1998), professional chemists continue to have fun and satisfaction throughout their career with discoveries about how the physical world works. Laszlo (2004) stated that chemists play games with chemicals in a similar way as a child who mixes various colors in a paint box to see what comes out. In the same way, chemists ask themselves the question "what would happen if I change…?" This playful attitude can be extremely fruitful and can motivate scientists. According to Ames (1992) views on task motivation experiencing many different types of activities from various science subjects are motivational by providing providing relevance to range of students in the classroom.

Studies at junior high school, high school, and university levels suggest that fun activities and a playful atmosphere promote learning and positive attitudes. Palmer (1999) identified junior high school students' perceptions of their best science teachers and found that these teachers allowed students to do lots of interesting hands-on activities and made the lessons fun. Also, the students perceived these teachers as interested in science, enjoying science, and enthusiastic about teaching science. In a study with senior high school students, Court (1993) examined a playful environment in a cooperative physics class and found that much of the students' talk was directly on-task and very intense and that the cooperative structure of the lessons provided a positive and fruitful learning atmosphere. Jarrett and Burnley (2007; 2010) in research with geology students and faculty noted that the role of play/fun in early learning helped create interest in science. Minger and Simpson (2006) found that in an activity-based methods course preservice teachers' attitudes toward science changed in positive way. In another study, Palmer (2002) found that preservice teachers who observed children at an interactive science center recognized the importance of hands-on science teaching and the value of making science fun. Informal science education programs are reported to be more successful if participants evaluate them as fun (Kumagai, 1996; Hide, 1998; Murphy, 2000; Revetta & Das, 2002; King, 2006; Lakin 2006). The above research findings indicate that playful learning environments enhance students' engagement, creativity, attention span, and enjoyment. Also, preservice and in-service teachers developed positive attitudes toward hands-on science and making science fun for children.

Research on hands-on science in Turkey

The Turkish Ministry of National Education has revised its science and technology education program in parallel with the world constructivist reform movement. The vision of the new program was educating all students to be scientifically literate. This program aimed to educate children to be curious, inquirers, responsible, questioners and solvers of real life problems (MEB, 2006). The new Science and Technology Program (MEB, 2006) was developed based on the following teaching principles and methods: student-centered, student and teacher active together in learning, teaching based on various sources, teaching students how to learn, integrating science with other subjects, teaching science's multiple dimensions and meanings, and focusing on scientific inquiry. Various research studies have been conducted to test the effect of constructivist learning approachs such as hands-on science teaching, discovery learning, inquiry teaching, and problem based learning on students' knowledge and their attitudes toward science learning (Aydede & Matyar, 2009; Balım, 2009; Bulunuz, Jarrett, & Bulunuz, 2009; Çetin & Günay, 2006; Tatar & Kuru, 2009). They found out that hands-on learning improved students' achivement and attitudes toward science learning.

Several Turkish studies examine teacher attitudes on hands-on science teaching. Uzal, Erdem, Önen, and Gürdal, (2010) evaluated the impact of an inservice learning on teachers' views about hands-on science teaching. They found out that almost 100% of the teachers agreed that with the help of hands-on inservice training experience, they can conduct their own hands-on activities in their classroom. Ünal and Akman (2006) examined the early childhood teachers' attitudes towards science teaching and found a relationship between teachers' attitudes toward science education and their science instruction in kindergarten classrooms. Ayvacı (2010) investigated the development of science process skills for kindergarten chidren by planning suitable activities. He found that kindergarten chidren's science process skills developed by providing playful activities.

Bozdoğan and Yalçın (2009) examined the effects of elementary student participation in hands-on exhibits in a science museum and found a meaningful relationship between academic achievement and interest scores of the students. However, there is a gap between the ideal and real science teaching pratice in schools. Uluçınar, Cansaran, & Karaca, (2004) evaluated laboratory applications in science courses at urban primary and secondary schools based on teachers' critiques. The teachers rated conditions in laboratories as unsatisfactory, with classrooms so overcrowded that laboratories could not be used effectively and meaningfully. Bulunuz (2011) examined preservice elementary science teachers' background science project experience and found that participation in science research projects in both elementary and secondary schools was very low . One of the striking findings was that science project participation was lowest at the university. Qualitative anaysis of the data indicated that many participants perceived science textbook experiments, making models, and homework as "science projects." Content analysis of the interviews indicated that teacher-directed science projects created a barrier to understanding the phases of scientific inquiry such as creating their own question, designing investigations, and communicating results to others. These research studies indicates that more effort is required to achieve the vision of the new science curriculum in Turkey.

It is the researchers' view that motivation to make science interesting and fun in the classroom comes when the fun of science is modeled in university methods classes for preservice teachers. A goal of these courses should be to develop a sense of wonder, curiosity, and playfulness in teachers. The present research replicates a study conducted by Jarrett (1998) with American elementary preservice teachers. She found high positive correlations between preservice teachers' ratings of activities on interest, fun, and learning, and their intention to implement those activities in their classroom. The present study uses the same methodology with kindergarten preservice teachers using hands on activities that are appropriate for kindergarten children. This study has two main purposes. The first one was to explore the motivational qualities of hands-on science activities for preservice kindergarten teachers. The second one was to explore which activities preservice kindergarten teachers tend to use in their own classrooms. Specifically,

1. Is there a strong correlation between students' ratings of experiences as fun, interesting, and high in learning?
2. Are activities which students plan to use in their own classrooms rated higher on fun, interest, and learning than activities which they don't plan to use?
3. Which hands-on science experience are considered the most and least fun. And what characteristics do these experiences have in common?

METHOD

Participants and context

The research was conducted in a science method course in a kindergarten teacher preparation program at University in North-West of Turkey. When taking this course during their fourth term, students had previously done classroom observations but had not actually taught. There were 47 students, 3 males and 44 females with an average age of 20. The students had very little backround in science, having graduated from a Turkish literacy and social science branch of high school where they took only one science course at 9th grade. The course was taught in two sections, with 23 students in one and 24 in the other. There were approximately 44 hours of instruction (four hours a week for 11 weeks).

The course and instructional strategies

The main emphases of the course were to teach preservice teachers how to integrate play and science, and also how to integrate science with other subjects. Therefore the course was focused on hands-on activities especially exploratory hands-on activities that are fun and playful for children and also for preservice teachers. The majority of class time was spent doing hands-on activities designed to model integrating play and science teaching to clarify important concepts and scientific processes, and spark the interest of the preservice teachers. The methods course emphasized science process skills that involved making predictions, setting up an experimental design in which hypotheses are tested, gathering data, making observations, examining and evaluating result. The instructional methods of the course were based on the three stage model Play-Debrief-Replay developed by Wassermann (1998) for primary school children. In the first one, after providing the necessary environment with equipment and materials, the teacher gives some time for free hands-on play/exploration time for students to get familiar with science materials. In the second stage, the teacher and students reflect on their experiences, and discuss what they observed, what they tried and what they wonder about, and what was surprising or new for them. In the third stage, teacher helps students to draw conclusion from their experiences with connections to scientific concepts and principles.

A textbook was not used. A textbook was not used. Class activities were developed locally with a focus on local materials and resources or were drawn from Jarrett (in press, 2012). A series of life science lessons was implemented. The preservice teachers went on a nature walk to make observations and activities in the forest and meadows and identified living things in their natural habitat. They collected different types of flowers and examined them with magnifying glasses. They circled a small area with string and counted the different types of plants and animals and searched for evidence of plants and animals that live in the forest (e.g., bones, shells, seeds etc.). They collected pine cones, rotten wood, and moss from forest to built a semi aquatic-terrarium. The instructor provided a toad for the terrarium. Students held snails and conducted simple activities to learn more about snails. Students fed the toad with crickets and different kinds on insects and worms. In the class, they also had a silk worm as a pet, feeding it mulberry leaves and observing its life cycle. Class experiences also included physical science experiments with paper helicopters, cooking, dissolving, magnetism, chemical reactions, red cabbage juice as an acid/base indicator, floating and sinking, Cartesian diver, designing aluminium foil boats, growing plants from seeds and cuttings, and testing products (markers and paper towels). Also, the class did experiments with the senses, spinners and rollers, colour mixing, heat, light and shadows, water drops, and bubbles. The instructor provided materials for activities and guided students while they were experimenting, investigating, and exploring. The list of the activities can be found in appendix. The instructor facilitated preservice teachers' exploration by encouraging the following questions: a) what will happen if…, b) When I do this…. the following….will happen. c) What did you find out about…? d) Can you show me what happened when…? The instructor provided materials for activities and guided students while they were experimenting, investigating, and exploring. All students had an assigment to do an investigation. All students presented their results to the class and compared their results to their hypotheses.

Activity rating scale

At the end of the course, students filled out a rating scale on the science activities they experienced in the course. On five-point Likert Scale 1 (low) to 5 (high), they were asked to rate each hands on activity according to (a) fun, how much fun it was, (b) interest, how interesting it was, and (c) learn, how much they learned from it. Similarly, they were also asked to rate each activity according to how likely they were to use the activity in their own classrooms.

Table 1. Motivational ratings of activities which preservice teachers plan to use or not to use in teaching

	Fun	*Interest*	*Learn*
Plans to use activity			
M	4.18	3.99	4.42
SD	.40	.52	.38
Plans not to use activity			
M	2.91	2.90	3.34
SD	.62	.71	.84

Note: Based on a 5-point scale; 1=low; 5=high

RESULTS

Intercorrelations among preservice teachers' ratings

To determine the strength of the relationship between the students' ratings of the experiences as fun, interesting, and high in learning potential, a separate correlation matrix was computed for each person, showing how that person's ratings of all the activities were related. In this way it could be determined whether each person tended to rate specific activities similarly on the dimensions of fun, interest, and learning. These correlation coefficients were then averaged across the entire class to find the overall mean correlations between fun and interest, fun and learn, and interest and learn. The mean correlations between fun and interest ($r=.65$, $p<.001$), fun and learn ($r=.52$, $p<.001$), and interest and learn ($r=.54$, $p<.001$) indicated that the preservice teachers rated specific activities similarly on these three qualities.

Qualities of activities preservice teachers ıntend to use in the classroom

Specific activities were assumed to be highly motivating if the students indicated the intention to use the activities in their own classrooms. In order to ascertain whether the activities they intended to use and not use differed with respect to fun, interest and learning, the means on fun, interest, and learn for the activities they would use (rated 4 and 5) and not use (rated 1, 2, or 3) were compared using paired samples t-tests. Highly significant differences were found between the activities the students planned to use and the activities they did not plan to use on the three variables: fun ($t(43)=15.72$, $p<.001$); interest ($t(43)=11.098$, $p<.001$); learn ($t(43)=8.86$, $p<.001$). The means, shown in Table 1, indicate that motivation to do specific hands-on activities in the classroom was highly related to the fun, interest, and learning value of the activity for the teacher.

Qualities of most and least fun activities

To identify which activities were considered most and least fun, the mean rating of each activity was calculated using data from all the preservice teachers who did that activity. The activities were then ordered according to mean from most to least fun. For means and and standard deviations see Table 2. The standard

Table 2. Mean ratings of Activities from Most to Least Fun

Activities	*M*	*S.D.*
1. Bubbles	4,88	0,32
2. Paper helicopter	4,78	0,50
3. Make a red/blue carnation	4,74	0,64
4. Cartesian diver	4,61	0,64
5. Silk worms and life stages	4,60	0,79
6. Growing from seeds-germination activities	4,56	0,80
7. The empty box candle snuffer	4,50	0,78
8. Food chain; feeding toad with crickets	4,39	1,10
9. Snail observation study	4,30	1,22
10. Taste sight and smell	4,22	0,91
11. Rollers; rolling different kinds of soupcans down a ramp	4,22	0,91
12. Red cabbage juice as an acid/base indicator	4,22	0,98
13. Mixing food coloring	4,22	0,88
14. Light and shadows	4,22	0,92
15. Designing a aluminum foil boat	4,21	0,85
16. Color spinners (mixing the rainbow to get white)	4,15	1,09
17. How many drops of water will fit on the head of penny?	4,13	1,05
18. Taste comparisons	4,11	0,88
19. I wonder which objects are attracted and not attracted by magnets?	4,10	0,84
20. Spinning raw and hard boiled eggs	4,08	1,05
21. Spinning a top	3,95	1,16
22. What will happen if we put food coloring in food? Will it change the taste?	3,84	1,14
23. What will happen if we put bananas, apples, grapes, orange, pumpkin etc.. in water?	3,82	1,08
24. Observing corn seeds in carbonated drinks	3,76	1,00
25. I wonder what will happen if we rub magnet over a nail in one direction?	3,72	1,09
26. Markers; which markers washout most easily from clothes	3,69	1,09
27. I wonder what will happen if we rub the magnet back nd forth over the nail?	3,48	1,03
28. I wonder what will happen If we put a hard boiled and fresh egg in water and salt water?	3,48	0,96
29. What will happen if we put salt on ice	3,45	1,14
30. I wonder if we rub the magnet more times in one direction over a nail, would it be stronger?	3,44	0,95
31. I wonder whether an ice cubes will melt faster in the sun or in the shade?	3,41	1,09
32. What will happen if a plant is kept in the dark?	3,40	1,22
33. I wonder whether an ice cube will melt faster in a drink or by itself?	3,39	1,02
34. Testing paper towels for absorption	3,33	1,20
35. Making oil and vinegar salad dressing	3,27	0,94
36. Do suger cubes dissolve faster in sprite than in water?	3,25	0,98
37. What will happen if a plant doesn't have a drainage hole in the pot?	3,22	1,13
38. Cake making	3,06	1,01
39. Observing a peeled orange in water and salt water	3,04	1,04
40. I wonder what will happen if I put stone in vinegar?	2,95	1,13
41. I wonder wherher a suger cube dissolves faster in cold or hot water?	2,87	1,11
42. Dissolution of a suger cube by stirring	2,65	1,02

deviations of the high rated activities were smaller than those of the lower rated activities, indicating more agreement on the high-rated activities.

The five highest rated activities were (a) bubbles, (b) paper helicopters, (c) making a red and blue carnation by watering with food coloring, (d) Cartesian diver, (e) observing life stage of the silkworm, (f) growing from seeds-germination activities, and (g) the empty box candle snuffer. The standard deviations from these activities were low, indicating considerable agreement on their fun qualities. The higher ranked activities tended to be exploratory in nature, enabling the preservice teachers to experience something new in nonthreatening way. Also, these activities taught process skills in context, rather than in isolation. All involved observations without directly teaching observation; several involved other process skills as well. Finally the most fun activities involved or promoted social interactions and group camaraderie. The bubbles, paper helicopter, silk worms and life stages, growing from seeds-germination activities, food chain; feeding toad with crickets, and snail observation study were planned as group experiences. They evoked a lot of group sharing, as class members discussed their reactions and shared their understandings.

Students also did voluntary evaluations of the course through open–ended written comments. Following are student comments that indicated that the course activities was fun, interesting and was taught in a playful manner: "I spent much more fun time in this science course that I expected!" "This course was really interesting and exciting." "Since my elementary years, I hated all science courses. Because our teachers did not likely make any hands-on science activities in the classroom. At the beginning of this course, I thought that 'Oh, again we will study boring elements and calculations then I saw that it was not true! It was really a playful course."

CONCLUSIONS AND DISCUSSION

The findings of this study were similar to the findings of Jarrett (1998) in an American university, suggesting that, across cultures, the fun, interest, and learning potential of activities are highly related and motivational. The strongest correlation, between fun and interest, suggests that activities that involve the student in a playful way are the activities the students find most interesting. That these activities are also rated high in learning potential suggests that things people don't already know or understand may be most interesting and fun. The activity survey and voluntary evaluations showed that preservice teachers' interest increased and they were more enthusiastic about learning and teaching science through hands-on instruction. Our findings provide support for claims that teacher preparation programs must provide hands-on experiences that promote positive attitudes toward science (Marcuccio & Marshall, 1993; Glass, Aiuto, & Andersen, 1993). Also these findings are consistent with rearch on interest and attitudes (Palmer, 2004:2009; Minger & Simpson, 2006), and motivation theory (Glasser, 1998). Clearly, playful hands-on science activities fostered their interest, curiosity and participation in science activities. Students exibited enthusiasm in participating in activities and also in implementing their assigments. The hands-on activities had a large effect on young women's interest in science and their ability to use scientific reasoning.

Of the investigations which students rated as most fun, three are often considered toys: bubbles, paper helicopters, and Cartesian divers. The other two involved processes of living things which students observed in ways which were new to them. Student teachers especially liked the variety of inquiry-based activities and resources available in their environment, especially observing silk worms' life stages, feeding crickets to a toad, and observing snails. This finding corresponds to suggestions that science activities should be interesting and suitable for kindergarten chidren (Ünal &Akman, 2006; Ayvacı, 2010). Student teachers showed less interest and were less playful with other activities, such as dissolution experiments, cake making, observing plants in pots with and without drainage, and testing paper towel absorption. It would be useful to collect more detailed information on how much students learned about science from the more/less interesting and playful activities.

The finding that when students considered the activities fun, interesting, and of learning potential they were more likely to expect to use those activities in their own classroom has important implications for science education. This finding corresponds to research on successful informal science education programs reporting that participants rated the programs as fun (Kumagai, 1996; Hide, 1998; Murphy, 2000; Revetta & Das, 2002; King, 2006; Lakin 2006). This finding suggests that learning has motivational value in that the more students feel they learn, the more enjoyment and involvement they have in doing science activities (Ames, 1992; Stepans et al., 2001; Palmer, 2002; Bulunuz & Jarrett, 2008). Student teachers gained usable information about new instructional methods and became involved in students' laboratory experiences and independent projects, so they learned how to use hands-on activities and field trips in their own science lessons. Finally, most of the preservice kindergarten teachers reported great satisfaction with the science course. Through their own participation, they had opportunities to reflect on childrens' thinking and motivation. Many said it was one of their best experiences in behaving playfully.

This research suggests that qualities of activities in method courses may significantly influence teachers' enjoyment and promote engagement with science. Many of these hands-on activities had clear and positive benefits for the kindergarten teachers, hopefully motivating them to make science more interesting and enjoyable for children. Providing experiences which pre-service teachers enjoy, which stimulate their curiosity, and which teach content while modelling inquiry methods may be a key to breaking the cycle of the inadequate teaching of science. One implication of this study is that more fun hands-on activities throughout the curriculum might promote future teachers' learning and motivation in other areas.

Additional research should be conducted to determine which activities will be used by the kindergarten teachers when they have their own classrooms and how often the teachers conduct investigations with their children.

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Appendix: Activity Rating Scale

For the first three categories (i.e. fun, interest, and learning) write a number 5, 4, 3, 2, or 1 in the appropriate column which reflects your thought about this activity. The number 5 reflects that you had most fun, were most interest in, and had highest level of learning for an activity; the number 1 reflects the least. Put N/A if you did not participate in the activity. In the last column, also write a number 5, 4, 3, 2, or 1. A 5 reflects that you would definetely plan to use the activity, a 1 indicates that you would not consider using it.

Most 5 4 3 2 1 Least Definetely 5 4 3 2 1 No

Activities	Fun	Interest	Learn	Probably do with own class
1. Paper helicopter				
2. Pancake making				
3. Making oil and vinegar salad dressing				
4. Designing a aluminium foil boat				
5. Cartesian diver				
6. Observing corn seeds in carbonated drinks				
7. Observing peeled orange in water and salt water				
8. Dissolution of a suger cube by stirring				
9. I wonder whether a suger cube dissolves faster in cold or hot water.				
10. Do suger cubes dissolve faster in sprite than in water?				
11. I wonder which objects are attracted/not attracted by magnets.				
12. I wonder what will happen if we rub a magnet over a nail in one direction?				
13. I wonder what will happen if we rub the magnet back and forth over the nail?				
14. I wonder if we rub the magnet more times in one direction over a nail, would it be stronger.				
15. I wonder what will happen if I put a stone in vinegar?				
16. Red cabbage juice as an acid/base indicator				
17. I wonder what will happen If we put hard boiled and fresh egg in water and salt water?				
18. What will happen if we put bananas, apples, grapes, orange, pupkin etc. in water?				
19. Growing from seeds-germination activities				
20. Make a red blue carnation				
21. What will happen if a plant is kept in the dark?				
22. What will happen if a plant doesn't have a drainage hole in the pot?				
23. Markers; which markers wash out most easily from clothes.				
24. Testing paper towels for absoption				
25. What will happen if we put food coloring in food? Will it change the taste?				
26. Taste comparisons				
27. Taste sight and smell				
28. Spinning raw and hard boiled eggs.				
29. Spinning a top				
30. Rollers; rolling different kinds of soupcan down a ramp.				
31. The emty box candle snuffer				
32. Mixing food coloring				
33. Light and shadows				
34. Color spinners (mixing the rainbow to get white).				
35. What will happen if we put salt on ice?				
36. I wonder whether an ice cube will melt faster in the sun or in the shade.				
37. I wonder whether an ice cube will melt in a drink or by itself.				
38. How many drops of water will fit on the head of penny?				
39. Food chain; feeding toad with crickets.				
40. Snail observation study				
41. Silk worms and life stages				
42. Bubbles				