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The effect of pre-service science teachers' prior experiences on their interests about chemistry experiments

Zehra Özdilek^a *, Sevgül Calis^a

^a*Faculty of Education Uludağ University, Bursa, 16059, Turkey*

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Abstract

The aim of the study was to examine the learners' interests about chemistry experiments based on their previous science experiences. Sample of the study consisted of 52 first year pre-service science teachers. The data gathered through chemistry experiments which preferred by the learners and an open ended survey. Results showed that participants prepared a chemistry experiment which they found easy to implement and understandable. It was also concluded that the experiments that have been chosen by most of the students have not been tried before for reasons such as lack of equipment or teachers not demonstrating experiments at the school.

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1. Introduction

Laboratory and practical work has gained the attention of science education researchers throughout the past decade, although implementing of laboratory experiments in instruction is not a new teaching method (Tsai, 2003). Laboratory classes give an opportunity to students regarding to be more active with experiments by making observations and using some apparatus and equipment than the theoretical classes. There have been numerous studies in science education suggesting that there is a strong positive relationship between attitudes towards chemistry and achievement (Bennett et. al., 2001; Cukrowska, Staskun, & Schoeman, 1999). It is appear that learning is substantially depended on motivational factors such as interests in learning of students so that the learning activities give the learners a sense of meaning and satisfaction. Additionally, learning experiences in secondary school science classrooms are influential in students' subsequent science interests in university years. Hence, improving learners' opinions about their first-year learning experiences will enhance the likelihood of them continuing with a subject (Dalgty & Coll, 2005). For this reason, science teacher education programs in universities need to be more aware of pre-service science teachers' interests of their teaching practice in laboratory classes (Jurisevic et. al., 2008).

At university level, an important amount of experience of students will be needed for some specific skills which are often very limited, but they can be developed as needed with laboratory work (Mbajjorgu & Reid, 2006). Pre-

* Zehra Ozdilek. Tel.: +90 224 2942296; fax: +90 224 2942199

E-mail address: zozdilek@uludag.edu.tr

service science teachers might face some troubles which may affect to implement chemistry experiments when they become an elementary school science teacher if they do not gain necessary skills in their university education. Teachers need to be experienced a comprehensive process of professional development so that they will experience the same skills, knowledge, and thinking practices as their own students in order to implement the laboratory approach (Windschitl, 2003). Students tend to have negative perceptions of their laboratory classes if their instructors do not have enough experience (Dalgyt & Coll, 2005).

Therefore, the purpose of the study was to investigate how the first year pre-service science teachers' previous experiences affect their interests on chemistry experiments within a chemistry laboratory course.

The following research questions guided this study:

1. Which chemistry experiments were preferred by the pre-service science teachers to fill out a laboratory report-sheet?
2. What are the reasons expressed by the participants on selection of the chemistry experiments?
3. What are the prior experiences of pre-service science teachers relating the chemistry experiments?
4. What are the beliefs of participants about the contributions of previous practiced chemistry experiments in their learning process?

2. Method

The study was implemented with first-year students who were registered in a chemistry laboratory course during the 2009 Fall semester. Data were collected through chemistry experiment report sheets and a survey that included demographic information and open ended questions. Firstly, it was examined what pre-service science teachers prefer to prepare a report sheet and their prior experiences which potential reasons to affect their preferences. To examine participants' experiences at more depth, semi-structured interviews were also conducted with 5 of the participants. At the beginning of the study, the instructor of the *chemistry laboratory I* course introduced and explained to students how to fill out an experiment report sheet. Then, it was required that participants to investigate a chemistry experiment which they found the most interesting for them and prepare a report sheet about the experiment as individual. The chemistry experiment report sheets was examined by the authors and then an open ended survey was applied to investigate the reasons of choosing the experiments by the participants.

The Chemistry Laboratory I course is one of the required courses in the first year and first semester of the science teacher training program in Turkey. The suggested teaching time for the course is 14 weeks and the presumed time for the course instruction is two-hour application lessons per week. The course is the participants' first required practical chemistry course in the program. The reason for this is that the course provides an opportunity to put into practice participants' chemistry knowledge from theoretical chemistry I course. Therefore, the participants have to be very active while they are engaging the experiments that assigned.

2.1. Participants

The sample for this study was consisted of 52 first year pre-service science teachers in their first semester at the science teacher training program. There were 12 (23.1%) male and 40 (76.9%) female pre-service teachers. These participants were selected using purposive sampling on the basis of convenience and all of them reflected a willingness to participate. The pre-service teachers were aged between 18 and 22 ($x=18.5$) years .

2.2. Data Source

Data were collected using an open-ended survey that included demographic questions (gender, age, and type of high school graduated) and 9 open-ended questions related to the pre-service science teachers' prior experiences and interests on chemistry experiments. The focus items for the analysis asked:

1. What chemistry experiment have you chosen?
2. What was the main reason for you to chose the experiment ?
3. Would you be able to implement the experiment you have chosen at the laboratory by yourself?
4. Was there any equipment which took your attention when you were doing the experiment?
5. Have you done the experiment before while your elementary or high school years?
6. Do you remember any other experiments you have done before?

7. What chemistry experiment would you like to do instead of the experiment you preferred?
8. Please describe the contributions of chemistry experiments, that you think in chemistry instruction?
9. Did you do chemistry experiments while you were in elementary and secondary school? If no please state that what was the reasons that you think you did not do chemistry experiments.

3. Results

Data were analyzed using descriptive statistics including frequencies and percentages and a content analysis method. Results were organized according to research questions.

3.1. Frequency of preferred chemistry experiments

The majority (44.2%) of participants preferred the topic of separation methods, 21.2% of them preferred properties of matter, and a few of them preferred other topics such as gases, acid and bases, chemical reactions, and electrolysis to prepare an experiment report-sheet. However, most of the pre-service science teachers stated that they would like to do more complex experiments such as organic synthesis experiments (n=26), atom and radioactivity (n=11), acid and bases (n=10), chemical reactions (n=5) instead of the experiments they have chosen. Chemistry topics which preferred by the participants can be seen in Table 1.

Table 1. Preferred experiments of pre-service science teachers

Chemistry Topic	Chemistry sub-topic	f	%
Separation Methods	Separation of solid-solid mixtures with density and magnetism	9	17.3
	Separation of liquid-liquid mixtures with boiling point, solubility, and extraction	14	26.9
		23	44.2
Properties of matter	Determination of density of solids and liquids	3	5.7
	Examination of physical and chemical changes	2	3.8
	Determination of melting and boiling point of matter	3	5.7
	Evaporation	1	1.9
	Pressure	1	1.9
	The effect of the temperature on solubility	1	1.9
		11	21.2
Gases	Expansion of gases	1	1.9
Elements and compounds	electrolysis	1	1.9
	Compose of compounds	3	5.7
Cell batteries		1	
Acid and bases	The effect of acids to metals	1	1.9
	acids and bases	4	7.7
Chemical reactions	The effect of catalysis to chemical reactions	1	1.9
	Synthesis Reactions	1	1.9
	Burning Reactions	1	1.9
equilibrium	The effect of temperature to equilibrium	1	1.9
solubility product		1	1.9
conductivity	Electrical conductivity of matters	2	3.8
Total		52	100

3.2. Reasons expressed by the participants for selection of the chemistry experiments

The themes and sub-themes, frequencies, and illustrative quotations were presented in Table 2. The frequencies of the quotes indicating the experiments' preference reasons of participants can be summarized as follows:

Table 2. Reasons of selection of chemistry experiments

Category	f	Sub-Category	f	Illustrative quote
Learning	22	Concretization	12	This experiment would help to concrete the abstract concepts.
		Related to daily life	3	Because the experiment was related to daily life
		To be related to elementary level	4	As I will be a science teacher for elementary school students I preferred an experiment which is elementary level
		Understandable	3	This experiment is very understandable.
Learner	18	Experienced before	5	I did the experiment when I was at high school. As it can be seen previous experiences have been affected for choosing a topic
		To be the most favorite subject	4	Reaction rate was the most liked chemistry topic when I was at high school and the effect of catalyses to reaction rate had been took my attention. For this reason I choose the topic.
		To be interested in topic	7	I wondered the effect of temperature to dissolution rate of molecules
		To feel comfortable to do the experiment	2	I would feel comfortable when I doing the experiment
Nature of experiment	14	Interesting	11	The experiment of separation of mixtures took my attention
		funny	1	I think that it is a funny experiment
		First experiment	2	I was the first topic of our chemistry laboratory course.
Implementing	11	Easy to implement	9	It is very easy to do in laboratory
		Easy to find needed materials	2	It can be find easily the needed materials for the experiment

3.3. Experiences of participants on chemistry experiments

While 16 of them, who experienced the preferred experiment before, stated that they can do the experiment, 3 of them stated that as maybe, on the other hand, 21 of them, who did not experienced the preferred experiment before, stated that they can do the experiment, 4 of them stated that they can not, and 9 of them stated that as maybe by individually.

77% of the participants stated that there is no any experiment apparatus or equipment took their attention as all the materials can be found easily in daily life, 21% of them stated that very basic laboratory apparatus took their attention such as erlen, measuring cylinder, glass stirrer, and only 4% of them stated the incubator and Liebig condenser as any apparatus which took their attention in the experiment they preferred.

63.4% of the pre-service science teachers stated that they have never done chemistry experiment they preferred and 36.6% of them did in their previous school life. The majority (57.6%) of participants stated that they have never did any other chemistry experiment in laboratory in their previous education, the rest of them could remember generally only one experiment they did such as acid and base, separation, and the reaction of water and sodium.

Pre-service science teachers highlighted several possible reasons why they did not do chemistry experiments in their previous school life. The majority of statements in this area (n=28 of total 67) focused on the lack of apparatus of experiment and 25 of them focus on the role of the teacher, such as teachers preference for traditional teacher-centered methods and not desire to take time and effort. Additional comments related to the lack of adequate laboratory infrastructure (n=12), anxiety of university entrance exam (n=1), and class size (n=1) for implementing chemistry experiments.

3.4. Beliefs of participants about the contributions of chemistry experiments in chemistry instruction

The participants stated that there were many contributions of chemistry experiments in their chemistry education, as ensuring permanent learning (n=25), helping students learn easily (n=17), concretizing the abstract concepts (n=1), and helping their satisfaction about the lesson (n=7).

4. Conclusions and Discussion

This study was conducted to investigate the effect of the prior experiences of pre-service science teachers on their interests about chemistry experiments. Based on the findings of the study, the following conclusions can be made:

Although pre-service science teachers would like to do higher level chemistry experiments, they preferred to prepare easy and basic chemistry experiments for laboratory report-sheets as they think having no any practical experience on the chemistry experiments in their prior education. Pre-service science teachers believed that chemistry experiments were very effective on long lasting and meaningful learning which will lead them to desire doing higher level experiments like chemical reactions such as acid and bases, synthesis of organic matters, and radioactivity at the chemistry laboratory. They also highlighted that they did not tried chemistry experiments due to lack of equipment, laboratory, and teacher attitudes in their previous education. The reason for that, they stated that they would like to do both higher and elementary level chemistry experiments within the chemistry laboratory courses for which be able to implement the experiments when they become a science teacher. Possible reasons for this may come from the fact that pre-service science teachers do not have enough experience about laboratory learning environments and they should also experience the process, so that they will be able to implement the chemistry experiments to their students better (Windschitl, 2003).

There is also a strong positive relationship between attitudes and success in first year chemistry (Cukrowska, Staskun, & Schoeman, 1999). If pre-service science teachers have difficulties with implementing experiments, especially chemistry, and that this may cause negative attitude towards their future science teaching (Jurisevic et. al., 2008). In conclusion, it can be said that pre-service science teachers' previous laboratory experiences have been affected on their interests of chemistry experiments. Therefore, it is recommended that it should be given more opportunities to pre-service teachers to do more chemistry experiments by using effective and appropriate teaching methods as well students at elementary and secondary level.

References

- Bennett, J., Rollnick, M., Green, G., & White, M. (2001). The Development and Use of an Instrument to Assess Students' Attitude to The Study of Chemistry. *International Journal of Science Education*, 23(8), 833–845.
- Cukrowska, E., Staskun, M. G., & Schoeman, H. S. (1999). Attitudes towards chemistry and their relationship to student achievement in introductory chemistry courses. *South African Journal of Chemistry*, 52 (1), 8-15.
- Dalgety, J., & Coll, R., K. (2005). Students' perceptions and learning experiences of Tertiary-Level chemistry. *Canadian Journal of Science, Mathematics and Technology Education*, 5(1), 61-80.
- Jurisevic, M., Glazer, S. A., Pucko, C. R., Devetak, I. (2008). Intrinsic Motivation of Pre-service Primary School Teachers for Learning Chemistry in Relation to their Academic Achievement. *International Journal of Science Education*, 30(1), 87-107.
- Mbajjorgu, N. and Reid, N. (2006) *Factors Influencing Curriculum Development in Chemistry*, Higher Education Academy, Hull, ISBN 1-903815-16-9.
- Taitelbaum, D., Mamlok-Naaman, R., Carmeli, M., & Hofstein, A. (2008). Evidence for teachers' change while participating in a continuous professional development programme and implementing the inquiry approach in the chemistry laboratory, *International Journal of Science Education*, 30(5), 593–617.
- Tsai, C.C. (2003). Taiwanese science students' and teachers' perceptions of the laboratory learning environments: exploring epistemological gaps. *International Journal of Science Education*, 25(7), 847-860.
- Windschitl, M. (2003). Inquiry project in science teacher education: What can investigative experiences reveal about teacher thinking and eventual classroom practice? *Science Education*, 87, 112–143.