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Investigation of Pre-service Science Teachers' Views and Opinions on the Use of Experiments in Science Education

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Abstract

The aim of this study were to investigate the methods used by pre-service science teachers when they are carrying out experiments; to see what needs to be done when test equipment's are not sufficient, and to reveal out their views on the use of the simple tools that can be used in the experiments. To view these changes, the study has been carried out by using pre and post- test design. In the study, an open-ended questionnaire, which was analyzed by using the qualitative content analysis method, was used to determine the differences in the views of pre-service teachers before and after laboratory courses. The results showed that the important part of the pre-service teachers have stated that prior to lab practices students need to do experiments in groups, and after the lab practices, the other important part of them stated that every student should do the test individually.

Keywords: science education; laboratory; pre-service science teacher

Introduction

It is important to approach the events from the perspective of scientists, and scientific thinking and understanding of the nature of science, attitudes and behaviors are provided with the help of the experimental applications in science classes towards science (Carnduff& Reid, 2003). Information obtained in a systematic and orderly way with the understanding that scientific knowledge and models can also change over time.Therefore, a crucial part of science education, experimentation is regarded as the focal point.

Learning occurs in the individual through repetition and experience and due to these permanent behavioral changes occurs. Memorization is needed when knowledge and skills, and experience start to break away. Memorization makes knowledge transfer and understanding more difficult (Caine & Caine, 1990). Therefore, interaction with the environment, exploring and using a variety of tools and materials, opportunities for exhibitions, multi-media presentations based on new and different learning experiences should be presented to students (Jacobs, 1990). According to Kolb's experiential learning model based on knowledge of the individuals learn through senses, feeling or thinking, watching, or doing things with their own experiences (Kolb, 1984, p. 40). In support of these findings in Piaget's theory of cognitive development,, the importance of the experience gained and thetools and methods used have been emphasized (Çilenti, 1988). Therefore, in laboratory studies, it is important for students to learn by using tools and materials.

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For laboratory practices to take place prerequisite is not to have a lack of tools and equipment. However, in the studies it is seen that when carrying out experimental applications pre-service teachers encounter with some difficulties such as lack of resources, and materials in schools and even though there are labs at schools these labs are not fully equipped. In addition, it is known that due to the lack of laboratory practical classes and the physical infrastructure pre-service teachers explain things theoretically.

In some of countries, laboratory facilities at schools are very limited. Therefore, it is extremely important for teachers to have the ability to try taking an advantage of their surrounding facilities to design an experiment by themselves. Teachers provide students easy supply to be reached by taking an advantage of the tools and materials used in science subjects to help them associate things they learn with the daily lives of students by teaching them to integrate with science.

It is effective in creating future pre-service teachers with positive attitudes towards science education that would help students to be good at science and technology by being scientifically literate and knowing what is occurring around them. To this end, science education in all levels should be supported by laboratory practices.

Laboratory assisted cognitive learning lessons include affective products such as attitude, loving or not loving, and caring - concerning. However, the views and attitudes of the pre-service teacher regarding the efficiency of the lab practices are extremely important.

In the literature, the researches done regarding the importance and role of laboratories in science education, the construction methods, insufficient test equipment, and what needs to be done were negligible in determination of this research.

The Purpose of the Research

Research questions are created in the following manner:

- What are the opinions of the pre-service teachers upon the design of experimental applications?
- What are the views of the pre-service teachers in the absence of adequate tools and experiments?
- What are the opinions of the pre-service teachers on the use of the simple tools that can be easily obtained from experiments?

Program Analysis

In Turkish science curriculum (MEB., 2013) the necessity of teaching abstract concepts in laboratory practices has been indicated. In elementary and middle school science curriculum, it is being aimed to teach these concepts by trying, exploring the experiments, observing the results of the experiment, interpreting and discussing these while learning (MEB., 2013, p. 2-46).In Faculty of Education science teacher education 1st grade program, 1st and 2nd semester laboratory course has 2 credits for General Physics Laboratory I and II courses and 2 credits for General Chemistry Laboratory I and II courses which equals to critical 8 credits. In General Physics Laboratory I and II courses in order to teach the basic concepts for mechanical and electrical programs tests are performed. In General Chemistry Laboratory I and II, elementary and secondary science technology-science courses in addition to the working techniques lab practices aim to teach the safety rules, accidents and measures, lab materials and patterns of use.

Method

In the research, quasi-experimental method has been selected as research method, and pre-and post-test design was used for the uncontrolled group (Fraenkel&Wallen, 2006). Before the classes began for laboratory practices which lasted for 2 semesters data collection tool was given to the pre-service teachers as a pre-test. After pre-service teachers took lab practices lessons for 2 semesters (General Physics Laboratory I-II and General Chemistry Laboratory I-II) the same instrument was used as a post-test.

Participants

The participants of the research were 1st grade pre-service science teachers. The data was collected in 2013 - 2014 fall semester. At the beginning and end of the period of data collection the instrument was applied to 72 pre-service teachers.

Instrument and Data-Collection Procedure

In the research, an instrument tool was prepared after reviewing the 3-8 grades of the science curriculum and the higher education curriculum and after examining the literature. In order to ensure the appropriateness of the questions and the validity of the subject content, the construction methods of the experimental applications on the subject, what to do when the testing tools were not sufficient, and the literature on the use of simple tools that could be easily obtained in experiments were examined. Four experts (a faculty member, two research assistants and a pre-service teacher) were consulted in order to see whether the expressions in the experimental tool were sufficient to determine the teachers' view on the issue, and whether there were any unnecessary, need to be corrected or incomprehensible statement. Expert opinion was taken for ensuring the correctness of the language used in the instrument. Considering the feedback coming from the experts the necessary corrections have been made on the instrument tool. In addition, to identify the clarity, openness and validity of the terms, the instrument was piloted with seven pre-service science teachers. By relying on the views of the experts and the pilot survey results, the instrument has been finalized (see Appendix).

Data Analysis

The answers related to the questions given to pre-service science teachers were analyzed by utilizing the qualitative content analysis methods used in the research. By content analysis, each similar data was collected under common categories by the researcher and then these categories were finalized. For the better understanding of the data the resulting data was organized and interpreted. The data were analyzed through the following sequence:(1) data coding, (2) the creation of categories, (3) the regulation of the codes and categories, (4) the identification and interpretation of the findings.

Percentages and the response frequencies of the placed categories were calculated. In addition, in order to identify the common categories, the pre-service teachers' answers were constantly compared with each other. The repeated codes belonging to the pre-service teachers' common categories, frequencies and percentages of these categories have been created using the tables and prepared statements were interpreted.

Since some pre-service teachers having different views at the same time, in the table the total number of responses was greater than the number of pre-service teachers.

Findings

Opinions on the Design of Experimental Applications in the Laboratory and How These Opinions Changed

The views of the science and technology pre-service teachers who participated in the experimental applications in the labs and the related data based on these views were given in Table 1 in comparison to pre and post-test.

Table 1. The Opinions of the Pre-Service Teachers Concerning theConstruction of the Laboratory Experimental Application

	Pre-test		Post-test	
Responses of thepre-service teachers	**N**	**%**	**N**	**%**
Eachstudentexperimentshould be done on an individualbasis	11	12,5	23	31,5
Studentsshould do experiments in groups	33	37,5	14	19,2
Testingshould be done bytheinstructorfirstthenstudentshoul an individualbasis	14	15,9	18	24,6
Testingshould be done bytheinstructorfirst, then in groups.	24	27,3	11	15,1
Other	6	6,8	7	9,6
Total	88		73	

When Table 1 is examined a slight increase in the number of the pre-service teachers regarding their views about the construction methods of the experimental applications can be seen compared to the prior applications and the idea was like "every student should do experiments individually". The reason for some pre-service teachers having this view before lab practices has been stated as "to learn and to research with an individual effort" (3 participants), "to facilitate understanding" (2 participants), "to do experiments easily while teaching" (2 participants), "to facilitate learning" (1 participant), "to make the right decision" (1 participant), "to gain information" (1 participant), "before making an experiment to try and gain an experience".

From these how prospective pre-service teachers can learn, understand, how they can make the experiments easier, give the right decisions, and how they can gain experience by doing the experiments were being asked and while asking these questions it can be understood that they preferred doing individual experiments. After lab applications, some of the pre-service teachers said; to provide "the persistency of their thoughts" (5 participants), "to provide effective learning" (4 participants), "to have all student working in the group, and to learn by spending an individual effort" (4 participants), "to understand easier and provide better insight" (4 participants), "not to have all student working in the group, to learn by spending an individual effort" (2 participants), "to grasp the subject" (2 participants), "to gain individual responsibility" (2 participants), "to progress at our self-learning speed"(2 participants), "to realize the errors" (2 participants), "to avoid memorization" (1 participant), "to guide one to think and to do research" (1 participant), "to provide personal development" (1 participant), "to help to the development of skills" (1 participant), "to recognize the vehicles and the necessary supplies" (1 participant) were stated. These views focuses on the quality of pre-service teachers' learning, thinking, researching without memorizing, comprehending, recognizing errors, and their preference of doing experiments in order to have permanent, effective understanding and learning as an individual. In addition, it is thought that individual experiments are effective on the recognition of pre-service teachers' personal and psychomotor development. As in prior laboratory applications, learning with an individual effort and preferring individual experiments as it is expressed only after laboratory practices taking responsibility and individual learning speed were observed among the preferences.

In relation to the construction of experimental applications after the lab practices, despite the fact that there has been a slight decrease in the views of the pre-service teachers (37.5% - 19.2%) stated their opinions, as "students should do experiments in groups".

Some pre-service teachers who have the same views stated the reasons for their views as; "to detect the errors" (3 participants), "to fix the failures" (3 participants), "to grasp things better" (3 participants), "to do experiments easily while teaching" (3 participants), "to assist each other and to form stronger relationships together" (3 participants), "to learn through the arguments" (2 participants), "to be descriptive (2 participants), "to gain experiment and experience before doing" (2 participants), "to enjoy" (1 participant), "to achieve results easier" (1 participant), "to exchange information" (1 participant), "to gain the sense of

responsibility" (1 participant), "to transfer knowledge" (1 participant), "to gain working souls" (1 participant), "to divide the labor" (1 participant), "to provide persistence" (1 participant).

After the laboratory applications, some of the pre-service teachers gave their opinions in the similar way by saying "for the group members to share information" (3 participants), "to provide persistence" (2 participants), "to learn better" (2 participants), "to complete what is the student lacking amongst the group members" (1 participant), "to do experiment while enjoying" (1 participant), "to achieve better results together" (1 participant), "to convey information" (1 participant), and "for having insufficient tools and equipment" (1 participant). In this case, prior to the implementation of pre-service teachers although, they concentrated on the learning dimension after the experimental applications done with more groups they concentrated on the individuals on the basis of experimental applications that allowed them to be do things at ease. After pre-service teachers taking (General Physics Laboratory I-II and General Chemistry Laboratory I-II) lessons for 2 semesters it can be understood that doing things together and sharing are more influential than performing applications in groups for learning.

In terms of the construction methods of experimental applications there have been a slight increase compared to the post application (15.9% - 24.6%) in terms of their views as they said, "experiments should be done by the instructors first, and then students should do it individually". Before lab practices, some pre-service teachers expressed their views as; "before doing the experiment by seeing and by understanding how it is done to gain experience" (2 participants), "to grasp better" (2 participants), "to take the right decisions" (1 participant), "at first students need to be informed" (1 participant), "to reduce the mistake" (1 participant), "to make the experiment more effective" (1 participant), "to improve the student's self-esteem" (1 participant), "to reach results easily" (1 participant).

From these views it can be understood that prior to application of the laboratory of experimental applications of pre-service teachers in the process of informing students in size, reducing the error rate, trying to increase the effectiveness, facilitating the process of achieving results; gaining experience about the product, and the accuracy of the decisions taken by the instructor when conducting the experiment is shown to be more effective when experiments are done individually. After lab applications, some pre-service teachers expressed their views in the similar way by stating as; "to facilitate understanding" (6 participants), "to provide persistence" (3 participants), "to grasp the good" (1 participant), "to access results easily" (1 participant), "to learn better" (1 participant), "everyone spending an effort to learn individually" (1 participant), "to learn the use of the tools and utilities" (1 participant), "students lacking information" (1 participant), "student not having difficulties" (1 participant), "to prevent making mistakes" (1 participant), "to interpret the experiment before it is done" (1 participant), "to dominate the experiment" (1 participant). This situation after laboratory practices can be understood and thought as individual tests nominated by pre-service teachers' teaching staff than an individual conducting experimental implementation of the process that would facilitate an understanding, and an easy way to experiment and achieve results, individual effort, student information, no mistake prevention, trying to be dominant and managing interpretation; the permanent learning in product size, gripping and using tool to be effective on learning.

Due to a slight decrease in the views of the pre-service teachers regarding the lab applications (27.3% - 15.1%) of these pre-service teachers stated their opinions by saying, "the experiment should be done by the instructor first and then it should be done in groups". The pre-service teachers who had the same view before lab applications stated their views by saying, "to see and to gain experience before its done" (4 participants), "to avoid making mistakes" (3 participants), "to grasp better" (2 participants), "to do experiment easier" (2 participants), "to be more informative" (1 participant), "to reach to the right conclusion by arguing" (1 participant), "to avoid poor results, and harmful situations" (1 participant), "to inform students before experiments are done" (1 participant), "to show ways to the students" (1 participant), "to teach the use of tools and utilities" (1 participant), "to correct mistakes" (1 participant), "to understand better" (1 participant), and "to get help from the friends in the group" (1 participant).

After the lab applications, some other pre-service teachers mentioned their views in the similar way by saying, “to reduce the errors” (2 participant), “to make an easy and convenient way for testing” (2 participants), “to cooperate with group member” (1 participant), “to achieve efficient results” (1 participant), “to share responsibility” (1 participant). Before lab practices, the reason why pre-service teachers prefer this kind of testing can be understood as it is taking place on the grounds of solidarity in which mutual help and sharing are taking place. This situation reveals the thought that the pre-service teachers have in mind as they are taking laboratory practices related courses (General Physics Laboratory I-II and General Chemistry Laboratory I-II) over 2 semesters that after taking these courses amongst group members helping are more influential.

The method used by the pre-service teachers to do these experiments was expressed as under “other” category, “students can do experiments with any friend as a group”, (1 participant) “to provide persistence and for learning to be more effective, first student should show an effort then, pre-service teachers should show” (2 participants) and “to get into vocational preparation and practice students should do voluntary experiments and then they should work in groups” (1 participant). Again before lab practices, two other pre-service teachers stated their views as, “the experiments should be done by the instructors and students should observe it under the other category”. From this situation what pre-service teachers tried to achieve can be understood that they are trying to create their own experimental group, after they are trying on their own figuring out how the experiment can be done, and trying out the experiment in groups after it is shown by a student, or just watching how it is done. After lab practices, some pre-service teachers stated their opinions on experiments under the other category by saying, “experiments can sometimes be done individually or in groups” (1 participant), “complicated experiments must be done with the teaching staff” (1 participant), “easy experiments must be done individually” (1 participant), “if assistance is not needed, it should be done individually” (1 participant), “depending on the students individual characteristics it should be done individually or in a group” (1 participant) and “to fix the errors they should be identified first students must do it and then the instructors should correct them if errors occur” (1 participant). After laboratory applications, pre-service teachers decided to shape the conduct of the experiments that are being carried out depending on the circumstances of the experimental applications.

From this situation it can be thought that over 2 semesters related to the laboratory courses (General Physics Laboratory I-II and General Chemistry Laboratory I-II) the subject of the test, degree of difficulty, assistance where necessary and the student's individual characteristics when making the experiment are thought to be necessary when determining the steps by the pre-service teachers.

Views about the Absence of Adequate Tools and Equipment in the Laboratory and how these Views Changed

The pre-service teachers of science and technology who participated in the research regarding their views of what needs to be done in the absence of adequate tools and equipment have been analyzed and related data has been given in Table 2 as pre and post test.

Table 2: The Views of the Pre-Service Teachers in the Absence of Tools and Equipment and what Needs to be Done

	Pre -test		Post-test	
Pre-service teachersanswers	**N**	**%**	**N**	**%**
An alternativeexperimentshould be designedwiththeavailableequipments	42	58,3	54	75
Withtheavailabletoolsexperimentshould be done as it is shown.	13	18,1	13	18,1
Intheabsence of toolsandequipment’sexperimentsshouldn’t be carriedout	14	19,4	4	5,5
Other	3	4,2	1	1,4
Total	72		72	

When Table 2 is analyzed a slight increase can be seen after the lab practice compared to before (58.3% - 75%) of the pre-service teachers gave their views about the absence of the tools and equipment and said "an alternative experiment should be designed which would enable the use of the available tools". Before lab practices, some pre-service teachers with the similar views stated the reasons for their views by saying, "to prove information" (1 participant), "to have an idea" (1 participant), "to achieve results" (2 participants), "to contribute to students experiences through experiments" (1 participant), and "to be productive" (1 participant).

After laboratory practices, some pre-service teachers with a similar opinion stated as "to teach students the subject" (1 participant), "for not being able to find every material all the time" (1 participant), "to develop creativity" (1 participant), "to see the purpose of the test" (1 participant), "not to waste time" (1 participant). Before lab practices, some pre-service teachers who had similar views by saying, "to prove information" (1 participant), "to have an idea" (1 participants), "to achieve results" (2 participants), "to contribute each students experiment" (1 participant), "to produce" (1 participant). Some pre-service teachers who had a similar view said "to teach the subject to students" (1 participant), "for not being able to find every material all the time" (1 participant), "to develop creativity" (1 participant), "to see the purpose of the test" (1 participant), and "not to waste any time" (1 participant). Before and after lab practices, some pre-service teachers stated their views by mentioning the reasons as "in any case, experiments should be done" (5-3 participants), "doing experiment is better than not doing" (3-7 participants) because, "to learn" (3-3 participants), "to ensure the permanency of knowledge" (1-3 participants), "to grasp" (1-2 participants). This view is extremely important for the pre-service teachers before taking the related courses over 2 semesters (General Physics Laboratory I-II and General Chemistry Laboratory I-II) as more than half of them suggested that the experiments should be done with the available tools and their positive attitudes should be put forward. Furthermore, even though after applications it has been found out that there weren't enough tools and equipment, it was effective for the alternative experiment to be created, to enhance creativity, to make learning permanent and in all conditions to spend an effort on learning, and in order to reach all these it was found out that courses that are being taken related to experiments are effective on the creation of these skills.

Although there has not been any change in the views of the pre-service teachers (18.1% - 18.1%) before and after lab applications, they stated their opinion as; when the equipment is insufficient "experimental demonstration should be made with the existing materials". Before lab applications, some pre-service teachers stated the reasons for their views as "to see how the experiment are done" (2 participants), "to keep up with the tests" (1 participant), and "to show students how these tests are done" (1 participant).

After lab applications, some other pre-service teachers stated the reasons for their views as "the more experiments are done, the better it will be" (1 participant), "to provide learning in any case" (1 participant), "to get attention" (1 participant), "to ensure persistence" (1 participant). Before and after lab applications, some pre-service teachers stated as "to understand experiments better" (1-1 participants), and "it is better to do an experiment than not doing" (1-3 participants). This situation is thought to result from the related courses that the pre-service teachers take for 2 semesters (General Physics Laboratory I-II and General Chemistry Laboratory I-II) that in the absence of adequate tools and equipment experiments are needed to be done by an instructor or results from a group of students when this is being carried out like a show. In addition, it is very important to see the pre-service teachers carrying out experiments like a demonstration before applications and before starting to take courses that would give them a chance to demonstrate their willingness on the subject matter.

Despite the decrease in the views of the pre-service teachers compared to the results prior to applications (19.4% - 5.5%) of the pre-service teachers gave their views on the tools and said "experiments should not be done if the tools and equipment are insufficient".

Before lab applications, some pre-service teachers stated the reasons for their views as "to avoid reaching missing, incorrect, inaccurate results" (7 participants), "because not doing an experiment is better" (1 participant), "because doing a good observation will not be possible" (1 participant), "the result of the experiment will not be trusted" (1 participant), while after laboratory "to experiment with the missing material would be a waste of time" (1 participant) after lab applications "it would be a waste of time doing experiments with missing equipment and tools" (1 participant). Some other pre-service teachers before and after lab applications mentioned their reasons as because "the subject will not be fully understood" (2 participants). From these views it can be thought that there may be a negative effect on the understanding of the subject, test results will not be reliable, and it will be time consuming, and the nature of observations' and understanding of these won't be reliable. The pre-service teachers who had the same view before or have a view about the insufficiency of supplies on previously experimental applications are thought to have negative experiences. The pre-service teachers who had a negative view seemed to have decreased after the applications after taking laboratory work related courses (General Physics Laboratory I-II and General Chemistry Laboratory I-II) over 2 semesters.

Before laboratory practices, a portion of the pre-service teachers have been identified by giving their views under the "other" category when there was not enough tools and equipment that "with the existing materials on the issue another experiment must be done not related to the subject" (1 participant), "the material to be provided should be expected" (1 participant), "pre-service teachers must provide materials" (1 participant), and after laboratory practices "materials should be taken as a class" (1 participant). The required tools for experimental applications to be provided by students and pre-service teachers and to be tested are very important in preventing any negative situation that may arise. However, one other pre-service teachers expressed his thoughts by saying that performing an experiment which has no relation to the subject can only mean it is only being done for the sake of doing something and they think appropriate tests must be done to ensure acquisitions.

Opinions on the use of the Tools that can Easily be Supplied in Experiments and how These Views Changed?

The views of the pre-service teachers who participated in the experiment have been analyzed regarding the use of the tools and these results have been given in Table 3 as pre-test and post- test.

Table 3: The views of the Pre-Service Teachers on the use of the Tools that can Easilybe Used in Experiments

	Pre -test		Post-test	
Pre-service teachersanswers	**N**	**%**	**N**	**%**
Goal of experiment	13	22,8	6	8,2
Easilyreach of tools	8	14,0	19	26,0
Affordability (time andcost)	8	14,0	12	16,4
Basis of makingtheexperiment	7	12,3	6	8,2
Learning andteaching	6	10,5	2	2,7
Ease of construction of experiments	4	7,0	5	6,8
Easyuse of thetoolsandexperiments	4	7,0	3	4,1
Basis of theiremotionalinput	1	1,8	4	5,5
Other	6	10,6	16	22,0
Total	57	100	73	100

It has been identified that three of the 72 pre-service teachers gave a negative feedback on obtaining the tools easily for experiments. However, 57 pre-service teachers expressed positive views on the grounds due to be announced along with the opinions of pre-service teachers when calculating the percentages for the total number taken as 57.

When Table 3 is analyzed, although there have been some reductions in the views of the pre-service teachers' (22.8% - 8.2%) it has been observed that they stated their opinions based on the purpose of the application regarding the use of the tools in experiments that can easily be obtained. Before and after lab practices, the pre-service teachers who held this view stated as “to reach the target in experimental applications material is required” (11-6 participants) and some other pre-service teachers stated their views before laboratory practices as “to do it again” (1 participant) and “to concretize it” (1 participant). These views reveal the fact that they thought they would be effective in achieving the goal on the use of the tools and supplies in terms of reaching these goals, doing it again, and concretizing.

Along with an increased amount of laboratory practice pre-service teachers (14.0% - 26.0%) stated their opinions in terms of accessibility, which can be easily obtained in experiments using simple tools and supplies. Before and after lab practices, pre-service teachers who held this view stated as, “to find time when they want” (5-15 participants), “when broken or damaged to prevent the disruption of the experiment and to put back in place immediately” (3-1 participants) and some others stated as “to avoid the shortage of materials” (3 participants). From this it can be understood that they think it is necessary to find tools easily and quickly, and to avoid a shortage of the supply. After the increase in laboratory applications their opinions were considered to be informed about the experimental activity that should be within easy reach of the students and they believed it happened as a result of not having enough knowledge on the choice of equipment and tools.

After a slight increase in the views of the pre-service teachers after lab applications (14.0% - 16.4%) have explained their views considering affordability (time and cost), the cost of the materials and tools (% 14, 0-% 16, 4). Before and after lab practices, some pre-service teachers who had this view stated their reasons as because “it’s economic in terms of time and finance” (6-12 participants), and others prior to experiments said “to do experiments quickly”(1 participant), and “for groups not to wait for each other” (1 participant).

This reveals the truth that because pre-service teachers can obtain tools easily that will be used in the experiments, and they are easy to be obtained and has a less cost they were seen more useful and suitable.

After laboratory applications, although there has been some reduction in the views of the pre-service teachers (12.3% - 8.2%), they stated their opinions by looking at the easily obtained and used tools and supplies in the experiments and mentioned their views on the basis of making the experiment. Before and after lab practices, pre-service teachers who had the same view stated their opinion as, “making an individual experiment”(6-4 participants), and “making experiments in groups” (1-2 participants). From these words, it can be understood that pre-service teachers think that the tools and equipment on the experimental application of the construction is efficient and they can easily be supplied by simple tools and in case of using tools and equipment shortage without depending on the circumstances an experiment can be done as an individual or in groups.

Although there has been a decrease in the views of the pre-service teachers after lab applications (10.5% - 2.7%), they stated their opinions based on the use of the tools and equipment from the learning and teaching perspective. Some pre-service teachers with the same view before and after applications stated their opinions as, “to facilitate understanding” (3-1 participants) some pre-service teachers before laboratory practice stated as “to simplify understanding” (2 participants), “to ensure learning that would be permanent” (1 participant) and after some laboratory practices “to consolidate the subject” (1 participant). Based on these views it can be understood and thought that tools and equipment help learning to be persistence, to be taught easily, and to consolidate the subject.

After lab practices although there hasn’t been a change in the views (7.0% - 6.8%) pre-service teachers expressed their views by taking into account the ease of construction of experiments using simple tools and supplies. The pre-service teachers who held the same view before and after lab practices expressed their views as; “not to make an experiment difficult, but easy” (3-5 participants), and prior to applications, one pre-service teachers stated as; “to make the experiment simpler”.

From these it can be seen that the pre-service teachers think that the use of tools and equipment are making the experiments easier and facilitating the construction of the tests to be done easier.

Due to a slight decrease in lab applications, some pre-service teachers stated their views by addressing to the easy use of the tools and experiments (7.0% - 4.1%), and after lab applications, some others (4-3 participants) stated as, "it is easy to be used". These views reveal the thought of the pre-service teachers that they think the tools that are easy are easy to be used.

Along with an increase in the views of the pre-service teachers after lab applications (1.8% - 5.5%), they have expressed their opinion on the use of the tools and equipment on the basis of their emotional input. Before lab practices, one of the pre-service teachers stated his opinion by saying "for not being afraid of experiments", after lab applications, three pre-service teachers stated as, "to avoid students cooling from the lesson", and "to attract students attention and to resolve student's curiosity". In the experiments, when complex and sophisticated set of experiments are used students' may be afraid to try, and may cool down from the lessons. Therefore, the experiment may not be interested. To avoid these negative situations and to arouse curiosity in students it can be understood that pre-service teachers emphasize the use of the simple tools and equipment.

Some pre-service teachers stated the use of some simple tools and equipment in experiments under "other" category and before lab applications stated as; "to do larger number of experiments" (3 participants), in terms of some scientific process skills in size "to prove experiments" (2 participants), some in terms of security "because the danger is less (1 participant). After lab applications, a portion of the pre-service teachers stated their views in terms of the student's level because "it is appropriate to the level of young children" (2 participants), "tools diversity in terms of finding all kinds of materials to experiment with a chance" (1 participant) the product in terms of "we will reach the wrong conclusion for the missing ingredients" (1 participant) and in terms of the probability of error "to reduce errors in the experiment" (1 participant).

Some pre-service teachers gave their views after lab practices in relation to the real life by saying "in the context of daily living, to build a relationship" (2 participants), "to apply the information we learn in everyday life" (2 participants) and in relation to the experimental environment "to try in a different environment" (4 participants), and "to make individual experiments at home" (3 participants).

This situation is important to make associations between real life and information, to be applied in real life, to allow experiments done outside lab environment, and to be able to choose the necessary tool and equipment by pre-service teachers. In addition, prior to laboratory applications three pre-service teachers identified negative feedback on the easily obtained experiments and on the use of simple tools and equipment. From this it can be seen that the pre-service teachers prefers to use more complex and sophisticated set of experiments for the experiment to be permanent.

Discussion and Conclusions

Regarding the way experiments are being carried out in labs, prior to these applications about 2/5 of the pre-service teachers gave their views by saying, "student must do experiments in groups", after applications, only 1/3 of the pre-service teachers found to have said, "every student must be individual experiments". After lab practices, pre-service teachers with the view regarding doing an individual tests has been found to justify their views by saying; "not all students work in groups, so it would be better to do the tests individually"(2 participants), "to gain individual responsibility" (2 participants) and "to get individual responsibility" (2 participants), and "to move at our learning pace" (2 participants). When we come across with this situation it can be thought that coming across with a lot of difficulties during experiments such as; not having everybody work in groups, completing preparation before experiment, not fulfilling the right duties during tasks and after tasks, and encountering with so many other difficulties encourages them to choose individual experiments to avoid all these negative situations.

It is possible for students to be affected negatively who are working in groups when all the members of the group do not fulfill the task requirements by working together.

In such a case the student's individual effort, by fulfilling their own responsibility and preferring to learn at his/her own pace is a very natural result. However, student being successful and participating in the configuration of the knowledge is an important factor in social interaction (Lave & Wenger, 1991). Therefore, the relationship between social interaction and critical information has to be configured (Del Carlo &Bodner, 2009). Social interaction is revealed simultaneously when they are performing the tasks. Although labs are often thought as an academic environment the content of any of the information in these environments that support the configuration of social interaction is also very important (Del Carlo &Bodner, 2009).

In addition to these, as stated in the literature it has been stated that working in a laboratory in their classes and activities, by actively participating will provide learning on the achievement of individual study method and will be more effective than the (Koprowski&Périgo, 2000; Zales&Colosi, 1996), collaboration, research and is referred to as the scientific process skills (Lazarowitz et al., 1994; Okebukol, 1986). As mentioned in the literature, it is extremely important for group members to work together in groups, to take the responsibility of their work and to fulfill their duties, and also it is necessary to maintain and control all this. In order to understand whether the group members fulfill the tasks or not, it is not enough to investigate the reports that have been used to assess the written examinations. Even though students do not actively take part in a group in the experimental applications in order to get a passing grade they have to memorize the related issues, and they have to examine the report book of one member.

To avoid this, each member of the other group should prepare a peer assessment. Furthermore, practical exam should be done to motivate students and to help them take responsibility of the work done in groups when conducting experimental applications. After lab applications, there has been two and a half fold increase positively in the pre-service teachers views in terms of carrying out individual experiments that it helps learning to be permanent, understanding, facilitates comprehension without memorizing, thinking and researching, learning to spot mistakes and using the tools. In addition, some pre-service teachers stated that individual experiments conducted individually helps one to take own responsibility for their own learning speed in accordance with the progress of the individual's personal and psycho-motor development that has a positive impact on what they thought was, and for these reasons the experimental application should be made individually. This situation supports the thoughts of the pre-service teachers that are involving in individual experiments who reveal that these experiments help learning, understanding, grasping and detecting errors, taking responsibility, and to the improvement and development of individuals leaning pace. Pre-service teachers' views have also been stated as a support in literature to show that the students learn by doing and achieve results through their own efforts by allowing them to take part in individual applications (Nakiboglu&Sarıkaya, 2000).

Before lab practices, 2/5 of the pre-service teachers identified that the experimental application of tests that are done in groups may reveal errors. It is thought that it is important to detect and to correct errors.

When looking at it from the perspective of learning and understanding, it has been observed that applications done in groups enables learning, reaching the results easily, and provides explanation and permanency. Also experiments performed in groups mean helping the group gain the spirit of enjoying to work together, getting ready for the preparation of the profession, and is effective on gaining experience. When looking at this from the social perspective, it is determined that it helps the group members to take responsibility, to exchange information, to influence positively the division of the labor, and for these reasons they thought experimental applications must be performed in groups. After lab applications, 1/5 of the pre-service teachers gave their reasons as to why experiments must be done in groups by saying; "for learning to be permanent, to correct the deficiencies, to exchange information, to have fun while carrying out experiments, for reaching the accuracy of the conclusions, and all these affecting us positively".

In the same way, as mentioned in the literature, similar to the laboratory in batches of the events organized activity, learning, achievement (Koprowski&Périgo, 2000; Zaleski& Colon, 1996), to work together, research and the scientific process is said to have had a positive impact on skills (Lazarowitz et al., 1994; Okebukol, 1986).

1/6 of the pre-service teachers prior to lab applications before the experiments are done, do demonstration first. They have stated a positive view on the results that when students carry out their experiments individually especially by seeing the experiment to be done they gain experience, understanding. They learn to give the correct decisions, to correct informational errors, to minimize, to try to enhance the effectiveness of self-esteem development, and to reach the results positively. After lab applications, about ¼ of the teaching staff have observed that individuals doing experiments on their own nominated by the instructor helps the individual to understand better and comprehend, by seeking achieving permanent results, by doing experiments achieving results easily, trying to dominate the experiments and making related comments, preventing errors, learning to use the tools and equipment, they thought these are the reasons for them to support individual experiments and say why they should first be done by the instructors and then, the individuals. In addition, when pre-service teachers are not fully sufficient in terms of the tools and hardware, instructors thought that by just watching the experiment being carried out they can just watch it go by. In order to pre-service teachers perform individual tests done by the instructors it is a prerequisite to have sufficient knowledge and equipment in the laboratories.

If a pre-service teacher does not come to the lab fully prepared, there should be someone telling him/her what to do all the time. Furthermore, this could become a habit after a while. Other pre-service teachers may come to the laboratory, without having sufficient knowledge and equipment. This can lead to chaos in the laboratory environment. To avoid this situation, before trying out each experiment questions related to the experiment should be asked to the candidates, and those who are unable to respond to the questions should not be allowed to do the experiments.

Before lab practices, one-third of the pre-service teachers' thoughts were found out as after experiments are done in groups after shown by the instructors. This would provide experience and will make experiments easy. For the same situation, instructors observed that when these experiments are done in groups, it would help them gain understanding, explanation; way of achieving results, a technique of argumentation, and is effective in correcting and preventing errors. In terms of security, when pre-service teachers are performing such experimental situations, it has been understood that they think there would not be anything to endanger the safety of the place. Instructors were seen in the informative and guides in the tool use, and it was seen that they drew attention to the helping issue that would take place among groups. 1/6 of the pre-service teachers after lab practices gave their views on the experiments done in groups by saying that it is good in terms of reducing the errors, making the results more efficient, in terms of experimentation, facilitating relationships between individuals in terms of solidarity and has positive effects on sharing the responsibility of the work done. For this reason, experiments should be done by the instructors first, and then in groups.

Before lab applications, sixth of the pre-service teachers have been found to choose the design of the experiment according to the show. Demonstrations of experiments are usually carried out in the absence of tools and equipment, and dangerous experiments are done when highly professional skills are required as an effective method. However, pre-test should be done by the pre-service teachers and the media should be designed in such a way in which all students will be able to see, and this environment must not have any material that would distract the attention of the students. Before starting the experiment the pre-service teacher attracts the student's interest and this should be protected throughout the experiment. During the experiment, students should be activated by asking them questions, and the results should be found by the students.

At the end of the experiment it carries an utmost importance and is required by the pre-service teacher to make an assessment on the issue, and to summarize things to make the use of experiments better (Çepni, 2011). After lab practices, seven of the candidate's statements have been found out that for the tests to be performed depending on the ease and difficulty of the level of the test, situations that may or may not require help, taking students characteristics to a certain extent they stated that the experiments can be done individually or in groups with the instructors.

It has been determined that prior to lab applications about 3/5 at the beginning and about ¾ of the pre-service teachers at the end stated that "an alternative experiment should be designed with the available materials", "experiment to be done with the available materials and an alternative experiment should be designed".

Some pre-service teachers who had the same view prior to applications stated that when candidates try an alternative test to prove things and to achieve results is effective on producing things and contributes to the development of students. As mentioned in the literature, these views were supported in the similar way and expressed, by saying that laboratory activities are proved by theoretical knowledge, the laboratory method of generating ideas, and as putting results forward, and demonstrating these skills (Garnett & Garnett, 1995). After lab applications, some pre-service teachers stressed the need for an alternative experiment by saying that some pre-service teachers do experiments to enhance creativity and to teach the subject, to understand the purpose of the experiment, and to use the time efficiently in case of not having sufficient tools and equipment. As mentioned in the literature, in support of these views, it has been emphasized that lab practices help concepts to be learned easier, the subjects can be taught more effectively (Hilosky et al., 1998), develop the creative thinking skills and one other primary skill of lab practices is to develop the creative thinking skill (Hofstein&Lunetta, 1982), and it also has an active role in terms of the laboratory work, and time management skills (Carnduff& Reid, 2003). Also, before and after lab practices, it was found out and stated by some pre-service teachers that carrying out alternative test is better than not having a test as it helps to the understanding of the subject, and ensures the retention of previously learned issues. As mentioned in the literature, it has been shown that lab practices provide an opportunity to learn by doing and experiencing, and also helps learning to last longer (Tezcan, 2006).

Although there haven't been changes in the views of the pre-service teachers before and after lab practices, about 1/5 of them stated their opinion by saying, in the absence of tools and equipment "experiment should be done with the available materials like a show". Before lab practices, to show the pre-service teachers how experiments can be done and in order not to be left behind from the practices it was seen that they stated to do the experiments like a show in case of insufficient tools and equipment. It was also thought that the number of the experiments done is important when ensuring the retention of previously learned subject and attract student's interests. Although, before and after lab practices, it has been thought that with the existing materials experiments should be carried out to provide candidates better understanding, and to help them understand that it is better to do it than not doing. As mentioned in the literature, it has been stated in the same way that it helps the information learned to be persistent (Tezcan, 2006), to increase the interest towards the lesson (Çepni, 2011; Hofstein&Mamlok-Naaman, 2007), and labs are also found to be effective on supporting the conceptual understanding (Pickering, 1993; Hofstein&Lunetta, 1982).

Before lab applications, 1/5 and 1/20 percent of the pre service pre-service teacher stated that in case of insufficient tools, "experiments should not be done". Before lab practices in the case of insufficient tools and equipment it was observed and commented by the pre-service teachers that doing experiments in such cases would not give accurate results and would have errors, would not give an opportunity for observation and would be a waste of time and they suggested not having experiments in such cases at all. Before and after lab practices, it was understood that pre-service teachers accepted the fact that by using the materials and tools in hand and by not developing them, alternative experiments won't be designed unless they start seeking thinking methods and other alternatives.

However, the decrease in the view; "there shouldn't be an experiment in the absence of adequate tools and equipment" after the lab practice can be seen as a positive development. This decrease is related to the course (General Physics Laboratory I-II and General Chemistry Laboratory I-II) candidates have been taken over 2 semesters despite, having problems with the tools from time to time lab practices must always be done and alternative experiments must always be done like a demonstration.

Before lab applications, three pre-service teachers and after lab applications, one pre-service teacher claimed that in case of insufficient tools, they should be supplied and provided by the pre-service teachers and the instructors.

However, because this situation is not directly related to every tool and equipment, it is also important to fulfill the responsibility of the academic institution. In addition, pre-service teachers and students are required to supply these materials.

As stated by a pre service pre-service teacher, an irrelevant experiment done in a lab will not be helpful and efficient and it won't also be appropriate in terms of teaching and learning. The main purpose of the experiments should be to fill the aim not the formalities. The important thing is to conduct the appropriate tests to ensure the gains. After the work done it has been observed that about ¼ candidates before lab practices and 1/12 of them after the practices gave their opinions on the use of the simple tools and equipment based on the use of the intended application. It was determined that pre-service teachers thought that the use of simple tools and equipment are needed to do the experiments, to repeat and to embody the scientific facts. As mentioned in the literature, the pre-service teachers who are incapable of reaching the simple tools and equipment to do the experiments would be capable by using the simple tools (Onen&Comek, 2011). In addition to these, it was found that the establishment set up done by the nature of science provides better gripping of the basic concepts, principles and laws (Sarı, 2011); and these experiments done by simple tools are found to be effective on making the concepts more concrete.

After lab applications, comparing to before approximately two-fold increase has been seen in the views of the candidates saying why simple tools should be used when they can't find time, and when they encounter with a negative situation to replace it with a positive one, to avoid facing with problems. After lab practices, approximately 1/7 and approximately 1/6 pre service teachers identified the use of the simple tools and supplies as more economical in terms of time and cost. As mentioned in the literature, in thisresearch, due to having simple tools and making it easier to be used, they expressed their beliefs and said they should take part in the program (Onen&Comek, 2011). In addition, experimental applications done with simple materials and tools provide an equal opportunity for all students to be cheaper regardless of their socio-economic level. Students in such a situation make their own tests without memorizing learning by observation and inference, and carrying out cause-effect relationship (Hardal&Eryılmaz, 2004). Cheap equipment that are being found and used in experiments give them a chance to think positively in terms of time and being more economical and provide grounds for students to do more experiments in less time (Onen&Comek, 2011).

However, the schools that the pre-service teachers will carry out for experimental applications may not have adequate equipment. Pre-service teachers may accept not having adequate equipment to do the experiments as justifiable excuse. To prevent this view, seeing inadequate equipment as a failure that is blocking experiments can be overcome with the use of the simple tools.

Despite the slight decrease after the lab applications (12.3% - 8.2%) of the pre-service teachers by taking into account the use of the tools and equipment that are used to make experiments have expressed their views by providing an ease on both individual and group experiments. This situation puts forward the way pre-service teachers think which is; all students can do individual experiments, and besides this, they put the idea forward that depending on the requests these experiments can be done in groups. However, if there is insufficient equipment doing individual experiments won't be appropriate.

Therefore, these experiments should be done in groups. When looking at this from this angle, by using the simple tools and equipment, the selection of the shape of the experiments can be considered effective.

Although, there have been a decrease in the views of the pre-service teachers after the lab applications (10.5% - 2.7%), stated their opinions based on the use of simple tools regarding learning and teaching materials. A part of the pre-service teachers revealed their positive views on the effect of the process of learning and teaching comprehension of simple tools and equipment, instruction, learning persistency, and practice.

Also, it was determined and has been stated that it has a positive impact on the understanding and learning of the pre-service teachers because the use of the simple tools facilitates easy knowledge transfer and they stated that these experiments done should be included in the curriculum. The experiments done with simple tools and equipment have impact on the teaching learning process, facilitating understanding, providing permanency, and help learning by doing (Hardal&Eryılmaz, 2004; Onen&Çömek, 2011; Sarı, 2011). In addition, tools and supplies that are cheap and simple purchased from pharmacies, supermarkets have a positive impact on understanding the basic concepts and principles that are found in scientific experiments (Davis &Speer, 1990). However, with the help of using simple supplies, it is believed that it helps positively for the comprehension of the science and technology lesson and also regarding the skills and knowledge they could gain from designing the simple devices (Sarı, 2011). Scientific experiments conducted with simple equipment skills and theoretical knowledge enables the conversion of permanent information, and clear understanding of the concepts (Bloom, 2012).

Although not much of a change took place after lab applications, some pre-service teachers expressed their views by taking into account the ease of construction of experiments done using the simple tools and equipment and why these should be used by stating their opinions positively. As mentioned in the literature, for this it was said that these experiments done in such a way are more useful for students (Moura&Marcello, 1987).

Despite the decrease in the views of the candidates after lab applications, it has been determined that they stated their views in the context of the use of simple tools and supplies. This situation reveals the fact that pre-service teachers may encounter with some difficulties using more complex and sophisticated set of experiments. Experiments sets are designed according to the terms of the easy use are considered to be useful to avoid making an experiment as an excuse. In addition, when they face with complex and sophisticated set of experiments using laboratory of challenges for pre-service teachers this may lead to negative attitudes.

Along with an increased amount of laboratory applications it has been observed that after the applications, some pre-service teachers explained their views on the use of simple tools and supplies on the basis of input features to explain their opinions. Before lab practices, one, and after lab practices, three pre-service teachers have been identified their views on the use of the simple tools by saying that students should not be afraid of conducting experiments, and they should not keep themselves away from the lessons. Consistent with this view, to be one of the main variables in Bloom's mastery learning model students affective qualities of input features are covered. These characteristics are combinations of student's interests in the subject to be learned, their attitude that contribute to the development of their academic self-confidence. Positive impact has been identified on learning against the subjects that are there to be learned, positive attitude and academic self-esteem (Bloom, 2012). In addition, some pre-service teachers identify issues that can be solved by saying simple tools and supplies can attract the interest and curiosity of the students. In order to increase the student's interests on the lessons and activities, the positive effects on simple tools and equipment has been stated (Onen&Comek, 2011). Also, it has been seen that the use of simple tools and equipment can make lessons fun, enables disinterested students to participate in class (Sarı, 2011; Hardal&Eryılmaz, 2004). It was also found that using simple tools and supplies increases huge interests on the course.

Also, it is known that activities made with simple tools and supplies develop students' curiosity for science in a positive direction, and is also known that concepts are making it interesting (Bloom, 2012).

Some pre-service teachers expressed their views in terms of the environment they have identified which can easily be obtained in experiments on the use of simple tools and supplies before laboratory experiments such as the number of experiments, scientific process skills, and safety and after laboratory applications as tools diversity, product, probability of error, everyday life and in terms of the environment that the experiment is done.

Pre-service teachers opinion have been the same as mentioned Moura& Marcello (1987), they think that the use of simple tools for experiments is very beneficial for students as it helps to the development of students scientific skills (Yu & Bethel, 1991). Experiments done with simple tools establish relationships in daily life problems to be solved more easily (Onen&Comek, 2011). Positive feedback has been located on the use of simple tools and equipment that are being used in the labs because it is thought that it helps establishing connections with daily life, and it helps these problems to be explained that can arise from daily issues. Also experiments made with simple tools and supplies were found to improve the establishment of connection with everyday life and science activities that prepare students to take responsibility, and of course arouses their curiosity about science, their attitude and self-confidence in a positive direction. It is known that it makes concepts clearer, understandable, interesting, concrete, and turns the theoretical knowledge and skills into a permanent knowledge (Hirca, 2012). Besides, three negative opinions of the pre-service teachers have been reported before the lab applications on the use of simple tools. One of the pre-service teachers who gave a negative report on the situation expressed his reason by saying “an experiment done with simple tools won’t be permanent”. Regarding this it is believed that the pre-service teacher is saying that for the experiment to be more valid and have more permanent results, more complex and more sophisticated set of tools should be used.

Recommendations

Future research may be conducted through using qualitative methods such as interviews. Within the context of the research questions based on the study, the use of tools while carrying out laboratory experimental activities and alternative situations presented with the construction methods, and what to do in the absence of adequate tools and equipment based on these the exhibition of their behavior should be observed.

The present research tried to reveal out pre-service science teachers’ views and opinions. Similarly, pre-service teachers from other disciplines such as physics, biology and chemistry should also be studied because laboratories are crucial for also these disciplines. Finally, besides taking the views of teachers, students should be considered as the key factors to accomplish successful laboratory applications and integration of laboratory into science teaching. To this end, research studies about laboratory applications might be beneficial to carried out with student samples.

Whether pre-service teachers prefer simple tools to try out what will be presented to them in laboratory conditions as easy alternative experimental activities or whether they prefer more complex and sophisticated tools and materials for experiment sets must be observed and supported during interviews.

Appendix

The questions in the instrument that has been prepared to detect the views of pre-service science teachers in experiments based on experimental equipment in size and experimental applications are the following:

1. How should experiment be done in laboratories? Why?
2. What can be done in the absence of tools and equipment? Why?
3. Should simple tools be used that can be obtained easily in experiments? Why?

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