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OPINIONS OF SCIENCE AND TECHNOLOGY TEACHER CANDIDATES ABOUT PHYSICS LABORATORY AND COURSE

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ABSTRACT
Laboratories carry a significant place in science education. Since science and technology course includes the courses-physics, chemistry and biology, science and technology teachers should be competent for all the branches as well as in laboratory practices. Among the topics in science, the ones related to physics are believed to be difficult and scary for both the students and teacher candidates. For this reason, the present study aims to find out the opinions of science and technology teacher candidates about physics laboratory and course via metaphors by adding their views about the laboratory instructor from their own cases. Hence, a qualitative study was conducted by using three research questions: (1) Physics laboratory is like …..… because …….. (2) Physics course is like …… because …….. (3) If I were the instructor of physics laboratory course, I would……. Collected data was analyzed in term of content analysis by organizing student answers under proper themes regarding positive, negative and neutral approaches of students' opinions in addition to analysis of their suggestions related to the laboratory instructor. The study was concluded with recommendations for the improvement of the laboratories and course.
Keywords: science and technology teacher candidates, physics laboratory, physics course.

INTRODUCTION

Laboratories carry an indispensable place in science education. The fundamental philosophy of laboratory based education is the fact that it allows students to observe the consequences via experiments (Çepni, Ayas, Johnson & Turgut, 1997). As the recent trend in education requires more student centered, inquiry based and active learning process, providing students opportunities in laboratories is an influential method in term of science education. The approaches utilized in laboratories can be verification, inductive, scientific process skills, technical skills and discovery method (Çepni et al., 1997). By using different approaches, students are expected to learn the phenomena with experiences. Bahar (2006) reports the aims of laboratory practices as follows:

- To support the presented theoretical knowledge in the lessons with experiments
- To enhance students' discovery skills and develop their psychomotor skills
- To prove that scientific information is valuable in daily life
- To make students develop positive attitudes toward nature and living things
- To improve the creativity of students
- To make students acquire scientific methods and metacognitive skills
- To enhance students' communication and interpersonal skills
- To make students familiar with the laboratory materials and equipment
- To provide students practices and applications despite memorization

There are several studies in the literature regarding laboratory practices. To illustrate, Kanlı and Yağbasan (2001) researched the effectiveness of in-service training programs for physics teachers and found that teachers had difficulty for conducting physics laborotary practices due to lack of laboratories or laboratory equipments. Guzel (2002) researched science and technology teachers' needs about in-service training programs regarding laboratory practices in Turkey. As a result of this study, it was found that teachers needed in service trainings in order to utilize laboratory practices and

to follow the recent developments in science. Younger teachers showed more willing for such training programs than the olders. Kaya, Çepni and Küçük (2004) conducted a qualitative study to investigate the needs of in-service physics teachers about laboratory practices in Turkey and found that teachers did not feel themselves satisfactory for laboratory practices. Also, they stated that they did not want to take place in laboratories due to several reasons. Uluçınar, Cansaran and Karaca (2004) researched the opinions of elementary and high school teachers about laboratory practices in Turkey. As a result of the study, it was found that about half of the teachers utilized laboratories partially. Also, insufficient course hours, over students than ideal in the classes, performing demonstration experiments in general were determined as problems and limitations. Akkuş and Kadayıfçı (2007) conducted a study with high school chemistry teachers to compare their opinions before and after they attended to laboratory use course. The results indicated that teachers improved themselves by means of new approaches and methods in addition to the cognitive level of the questions they construct. Also, the belief which stated that laboratory was a place where students could learn new things was seen to be more common among teachers when compared to the beginning of the course. Koray, Köksal, Özdemir and Presley (2007) investigated the effect of creative and critical thinking based laboratory method on prospective primary teachers' science process skills and academic achievement. For this reason, they conducted an experimental study with 2nd year primary teacher candidates and found that experimental group showed progress as a result of the study.

In sum, present studies in the literature mostly regard in-service science teachers in term of their thoughts on laborotory and improvement of their laborotory skills. On the other hand, prospective science teachers' opinions are worth to study since they are going to take role as teachers in their own classrooms in the near future. In this case, metaphors can be utilized.

Yob (2003) defines metaphors as cognitive tools utilized by people to give meaning and explain highly abstract, complicated and theoretical concepts. According to Palmquist(2001), metaphor is a linguistic tool wich connects two objects or concepts and it is accepted as a language structure which connects two different concepts or opinions. They are encountered as nouns, verbs or adjectives in daily language use (cited in Arslan and Bayrakçı, 2006). One use of metaphors is reported to be their application in teacher education (Vadeboncoeur and Torres, 2003; 88 cited in Arslan and Bayrakçı, 2006).

Since science and technology course includes physics, chemistry and biology topics in elementary level; it requires competent teachers at all branches in order to provide a qualified science education. For this reason, science and technology teacher candidates take specific courses related to those brances as well as their laboratory practices during their undergraduate education. However; some topics of science course are not enjoyed by the students. Among them, the topics related to physics are believed to be difficult and scary for students and teachers as well (Bozkurt and Sarıkoç, 2008). Çepni et. al. (1997) indicates that most of things encountered in daily life are related to physics, chemistry or both and if students comprehended that physical or chemical phenomena are related to daily life rather than being abstract concepts, they would learn them easier with developing interest and good attitudes toward them.

Considering the aspects of science education mentioned above, this paper focuses on undergraduate students by combining their views about physics laboratory and physics course. Hence, in this study, it is intended to find out the opinions and perceptions of science and technology teacher candidates about physics laboratory and physics course via metaphors by determining their views about their ideal laboratory instructor considering their own cases.

METHODOLOGY

The study was conducted with the help of qualitative methods. Data was collected with a form developed by the researchers which has three open ended questions. The research questions used in the study are as follows:

(1) Physics laboratory is like ……. because ……..
(2) Physics course is like ……..... because …….. ……....
(3) If I were the instructor of physics laboratory course, I would…….

The sample of the study includes 60 3rd year science and technology teacher candidates studying at Balıkesir University, Necatibey Education Faculty in Turkey. The sample was selected via convenient case sample. The students were noted to have studied general physics laboratories and general physics courses in their previous years of university education and had enough experience and beliefs about those courses to gather relevant data for the study.

Qualitative methods were utilized in data analysis process. Data was analyzed in term of content analysis. Students' responses were collected under proper themes for each question and they were quantified by calculating their relative frequency and percentages. In addition, for the first and second question, students' responses were grouped regarding their positive, negative and neutral opinions for the physics laboratory and course. Neutral opinions indicate definition type of statements of students who reflect neither positive nor negative point of views from their reasons.

RESULTS

Results of the First and Second Question

Students' responses about physics laboratory and physics course were analyzed as a whole and their explanations in the second parts of first and second research question were classified as positive approaches, negative approaches and neutral approaches. Following statements are given below to illustrate students' responses:

- *Positive approaches:*
- Physics course is like a mobile phone because it is needed all the time.
- Physics laboratory is like funfair because it is joyful.
- *Negative approaches:*
- Physics course is like torture because it is very difficult to understand.
- Physics laboratory is like refrigerator because it makes me feel cold about life.
- Neutral approaches:
- Physics course is like a rock because there are unchangeable truths in it.
- Physics laboratory is like an electricity shop because there are electric circuits everywhere.

The findings of this classification are present in Table 1.

Table 1. Distribution of the students' reasons for physics laboratory and course.

Approaches	Physics Laboratory		Physics Course	
	N	%	N	%
Positive	21	35.0	12	20.0
Negative	16	26.7	34	56.7
Neutral	18	30.0	11	18.3
Irrelevant	5	8.3	3	5.0
Total	**60**	**100.0**	**60**	**100.0**

As can be seen in Table 1, 21 of the students (35.0 %) possess positive opinions about physics laboratory whereas 16 of them (26.7 %) possess negative opinions. 18 of the students (30.0 %) stated their opinions via definitions, with neutral approaches and 5 of the students (8.3 %) gave irrelevant response. When the physics course is considered, 12 (20.0 %) students presented positive opinions whereas 34 (56.7 %) presented negative opinions about it. 11 (18.3) students used definitions – neutral approaches to indicate their opinions and 3 (5.0 %) of the students gave irrelevant responses for the question.

After the classification of students' reasons about physics course and laboratory as positive (+), negative (-) and neutral (0) for each student, the ratio of them are analyzed considering all the cases for the responses given to course and laboratory as presented in Table 2.

Table 2. The analysis of students' responses about physics laboratory and course altogether.

Responses about course / lab.	+/0	+/-	+/+	- / 0	-/-	-/+	0/0	0/-	0/+	Irrelevant	Total
N	4	0	8	10	15	7	4	1	6	5	60
%	6.7	0.0	13.3	16.7	25.0	11.7	6.7	1.7	10.0	8.3	100.0

According to Table 2, 15 of the students (25.0 %) have negative opinions for both the laboratory and course whereas 8 of them (13.3 %) have positive opinions for both of them. 7 (11.7 %) of the students who possess negative opinions toward course indicate positive opinions toward laboratory. 6 of the students (10.0 %) who have neutral opinions for the course have positive opinions for the laboratory; 4 of them (6.7 %) have neutral opinions and 1 student has negative opinions for the laboratory. 4 of the students (6.7 %) possess positive opinions towards the course and neutral opinions towards laboratory. There are not any students who have positive opinions towards the course and negative opinions towards the laboratory in the research.

Student responses for the questions "*Physics laboratory is like …….* " and *"Physics course is like ……."* were listed and then analyzed in term of content analysis by considering their comman characteristics. As a result, they were examined under categories which grouped participants' metaphors as demonstrated in Table 3. Irrelevant responses for both laboratory and course as stated in Table 1 were not included in the analysis.

Table 3. Students' metaphors for physics laboratory and physics course.

Physics laboratory is like ……..			***Physics course is like ……..***		
Category	**Metaphors**	**N (%)**	**Category**	**Metaphors**	**N (%)**
Place	funfair (3), electricity shop (3), kitchen (2), TEDAŞ, world, pantry, mechanic room, science centre, factory, fear tunnel, classroom, home, junk yard, space, plane cabin, bee hive	**21 (38.2)**	**Feeling**	nightmare (6), torture (4), boring (2), problem, difficult, bogy, complicated, hard, dangerous	**18 (31.6)**
Object	electric circuit (2), toy, glasses, water, car, box, refrigerator	**8 (14.5)**	**Food**	honey (2), lemon (2), water, meal, cabbage pickle, diamond, bread, dessert	**10 (17.5)**
Feeling	necessary (2), terrible, great, love, good, sweet	**7 (12.7)**	**Activity**	memorize (2), travel, step, drive a car, to do an undesired job, get stuck, climb	**8 (14.0)**
Life	life (3), living(2)	**5 (9.1)**	**Object**	Mobile phone, rock, matter (2), waste, story book	**6 (10.5)**
Person	child (3), dad	**4 (7.3)**	**Place**	jail, space, storehouse	**3 (5.3)**
Activity	fly, measure, ride gondola, play	**4 (7.3)**	**Person**	mum, dad	**2 (3.5)**

			Life	life (2)	**2 (3.5)**
Not encoded	narrow, volleyball, exam, horror movie, idiom, speed of light	**6 (10.9)**	**Not encoded**	Nirvana, lightning, serial, Beşiktaş, music, simple machine, problem and experiment, simulation	**8 (14.0)**
Total		**55 (100.0)**	**Total**		**57 (100.0)**

According to Table 3, most of the students (40.0 %) relate physics laboratory with a place and relate physics course with a feeling (31.6 %). Similarly, 10.9 % (6) of the students used feeling expressions for physics laboratory and 10.5 % (10) preferred a food to define it. Students who use an object to define physics laboratory comprised 14.5 % (8) and this ratio is 10.5 % (6) for the physics course. 7.3 % (4) of the students define physics laboratory with an activity and this ratio is 14.0 % (8) for the physics course. The ratio of the students who relate physics laboratory with a person is 7.3 % (4) and this value is 3.5 % (2) for physics course. In addition, only 5.3 % (3) of the students use a place name to explain physics course. 9.1 % (5) of the students connect physics laboratory to life and this catogory has 3.5 % for the course. 10.9 % (6) of the responses for physics laboratory and 14.0 % (8) for the responses related to the course do not relate to any category hence they are not encoded.

Results of the third question

Analysis of the data collected from the question "If I were the instructor of physics laboratory course, I would……." is presented in Table 4 in the form of categories. Since one student could mention more than one theme, the total number of the themes are more than the total number of students participated in the study.

Table 4. Suggestions of the students for the laboratory instructors.

Category		**N**	**%**
1.	Make students construct the experiment set up themselves	14	21.2
2.	Not bore students	12	18.2
3.	Prepare more interesting and enjoyable experiments	9	13.6
4.	Continue as the same	7	10.6
5.	Prepare experiments related to daily life	6	9.1
6.	Make the experiments (instructor himself)	4	6.1
7.	Conduct smaller groups for students	4	6.1
8.	Conduct difficult experiments for the students	2	3.0
9.	Request students come to laboratory with preparation	2	3.0
10.	Conduct more experiments in number	2	3.0
11.	More classroom management	2	3.0
12.	Construct a more modern laboratory	2	3.0
Total		**66**	**100.0**

When Table 4 is examined, the students were seen to pay more attention to applications (21.2 %) if they were laboratory instructor. Also, 12 (18.2 %) of them stated that they would not bore students by asking less questions in the courses, making easier exams and being more tolerable for unattendance. 9 (13.6 %) of them expressed that they would prepare more interesting and joyful experiments. On the other hand, 7 (10.6 %) stated to continue the same present system. The same system in here indicates that students come to the laboratory by studying their experiment. They are asked questions before the experiment to check their pre-knowledge. The students who do not have sufficient knowledge about the experimental procedure are not allowed to attend the practice. The students who attend the practice follow the instructions in their lab manuel to take measures from the experiment set up and prepare a laboratory report related to the experiment performed.

In addition, 6 (9.1 %) of them stated that they would prepare experiments related to daily life. 4 (6.1 %) of them expressed that they would perform the experiments themselves. Again, 4 (6.1 %) stated that they would reorganize the number of the students in the groups. 2 (3.0 %) students for each suggested to make more difficult experiments for students, make students come to laboratory prepared, conduct more experiments in number, use more authority in the courses and construct a more modern laboratory.

DISCUSSION AND CONCLUSION

As a result of the study, it has seen that students use more positive statements for the physics laboratory than the course. Moreover, it has been found that more than half of the students (56.7%) possess negative opinions toward physics course. This value has stayed 26.7 % for the laboratory practice. The difference between two outcomes might be sourced from the fact that laboratory course is based on practice based learning. When the responses related to the course and laboratory practices are considered in detail, the students who own negative opinions for the course and positive opinions for the laboratory comprised 11.7 % of the total. However; the opposite of this situation has not been encountered. In another words, there are not any students who have positive approaches for the course and negative for the laboratory. In addition, only one student who possesed neutral expression for the course, had negative opinions for the laboratory. Those findings support that students enjoy physics laboratory more than the theoretical course and have more positive approaches to the practicals.

When the metaphors related to definition of physics course and laboratory are examined, it has seen that students mostly consider physics laboratory as a place. Only one statement of those metaphors indicate a negative opinion (fear tunnel) for the laboratory. Rest of the metaphors regard a positive thing or explained positively with its reason. However; all of the metaphors in the feeling category related to the course are negative (nightmare, torture, boring...etc.) The finding that expressions related to life is more comman for the laboratory practice than in the theoretical course can be considered as students connect laboratory practices to daily life more than the theoretical course.

The students expressed that they would make more practical experiments and make students prepare experiment set up themselves (Akdeniz and Karamustafaoğlu, 2003; Nuhoğlu, Kocabaş and Bozdoğan, 2004). It is obvious from the findings that conducting enjoyable experiments related to daily life is significant for the students. Several students indicated that they would prepare easier exam questions and conduct a relaxed course with no oral examinations. Also, the number of the students in the laboratory groups is a problem for them as seen in the responses (Akdeniz and Karamustafaoğlu, 2003). As a consequence, the types of experiments and student numbers in the groups can be evaluated in order to improve laboratory sessions. Also, relating theoretical knowledge taught in the physics courses to daily life might make the lesson more meaningful for the students.

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