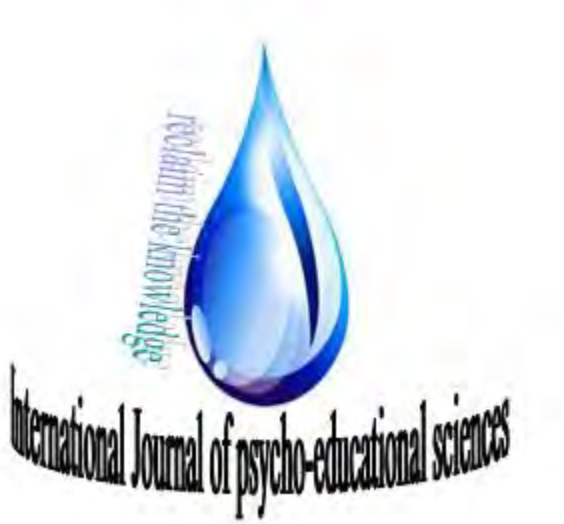

Determination of Prospective Chemistry Teachers' Opinions and Information Levels on Laboratory Safety

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Abstract
Activities carried out in the laboratory provide important contributions to students in terms of developing their research, problem solving, questioning, using hand skills and communication skills. However, providing safety during the studies in the laboratory environment is extremely important. The aim of this study is to determine information level and ideas of prospective chemistry teachers on laboratory safety. Descriptive method is used in study. The sample of the research consists of 58 participants who are studying in Chemistry Teaching department. Questionnaires and informal observations were used as data collection tools. From point of view of the obtained data, scores of the students in different grades in questionnaires were compared with ANOVA. A statistically significant difference was found between the scores obtained from the questionnaire ($F(3,57)=10,568$; $p<0,05$). Independent sample t test was applied to the data to determine whether the scores obtained from the questionnaire differed in terms of gender variable. According to the gender variable, there was no statistically significant difference between the scores obtained from the questionnaire ($t=0,231$, $p>0,05$). The questionnaire results show that prospective chemistry teacher are aware of the importance of safety issues, however, the results of informal observation showed that candidates did not work in the fume cupboard when working with some volatile substances, they poured all the chemical wastes into sinks and did not check the warning signs on the tubes. For this reason, it is suggested to give information about the safety in the laboratory lessons, sometimes to remind them and to spare time to give safety information in the theoretical lessons.

Keywords : Laboratory safety, laboratory warning and safety sign, prospective chemistry teachers

Introduction

Laboratory works are an indispensable part of chemistry and complementary. Because activities carried out in the laboratory provide important contributions to students in terms of developing their research, problem solving, questioning, using hand skills and communication skills (Hofstein and Lunetta, 2004). As a result of these, the relationships between learned concepts and concepts become more meaningful and permanent. The use of laboratory studies in chemistry teaching, the sharing of information about the subjects or concepts related to these studies, the acquisition of basic skills related to the scientific thinking as well as the attitude of being more sensitive towards the environment (Yılmaz and Morgil, 1999) and the acquisition of basic skills about associating what are learned to daily life are important.

The laboratory is the place where the student performs the experiment by using the equipments himself and, in short, where the learning by living and doing is carried out (Hamurcu, 1998). Therefore, there is a mobility in the laboratory when the experiment is conducted. The person who will provide the laboratory order and who will guide students about how they must work is the teacher of the lesson. Thus, an effective science teacher should have, apart from other skills, the ability to plan experimental researches and to work safely in the laboratory (YÖK / World Bank, 1997). Teachers are obliged to ensure the safety of their students and their working environment against the dangers that may occur during the lesson (Hamurcu, 1998). Therefore, safety is the most important issue to be taken into consideration during laboratory experiments.

Conducted researches show that a very small part of accidents happened in the laboratories are caused by technical errors, and a large part (85%) is caused by human errors (Bayrak and Ağaoğlu, 1999, p. 295). And very interestingly, it has been determined that

school laboratories included more dangers than industrial laboratories (Peplow & Marris, 2006; Langerman, 2009). Whereas, laboratory safety, especially in chemistry laboratories involving the transport of chemicals and working with chemical materials, must be one of the top priorities (Hill, 2007).

A science teacher is the master of his job, as long as he knows the hazards he may encounter in the laboratory environment and takes the necessary precautions (Bayrak and Ağaoğlu, 1999, p. 296). It is extremely important that prospective teachers know how to work safely in laboratories, that they are conscious of the characteristics of the chemicals they use in their experiments, and that they have the skills and information to provide a safe environment for their own health as well as for their future students. In addition, individuals should be aware of chemicals and hazard symbols not only for their own health and safety, but also for the health and safety of the laboratory and the environment in laboratory works that permit practical applications (Anılan, 2010). Some conducted studies have shown that the lack of warning symbols on chemical containers, the fact that the symbols are faded on the containers caused the accident in the laboratory (Mogopodi, Paphane and Petros, 2015) and therefore how much the warning signs are so important (Abbas, Zakaria, Balkhyour and Kashif, 2016).

The Aim of Study

The aim of this study is to determine information level and ideas of prospective chemistry teachers on laboratory safety. In the light of this purpose, the following questions are tried to be answered:

1. What are the ideas of prospective teachers on laboratory safety?
2. Is there a meaningful difference between information levels about laboratory safety of prospective teachers in terms of grade level and gender variable?

Method

Descriptive method is used in study. In descriptive approach, it is aimed to describe and examine an event and problem in detail. Evaluations are made in line with the determined standards and possible relationships between variables are tried to be revealed (Çepni, 2009).

Participants

The sample of the research consists of, totally, 58 participants, 19 first, 12 second, 15 fourth and 12 fifth grade prospective teachers studying at Karadeniz Technical University Fatih Faculty of Education, Chemistry Teaching Program.

Data collection

Questionnaires and informal observations were used as data collection tools. The questionnaire applied to participants was prepared by Kırbaşlar, Özsoy, Güneş and Derelioğlu (2010). The questionnaire covers subjects of laboratory safety, laboratory warning and safety signs. In the first part of the questionnaire, there are 12 questions to determine prospective teachers' thoughts on laboratory safety; In the second part, there are 12 questions to determine laboratory safety information levels of them. The 12 questions in the second part are the gap filling questions. The first 6 questions are for determining "laboratory safety information" and the other questions are for determining "warning and safety signs information".

Prospective teachers have been observed at different times for a total of 16 lesson periods (4x50 minutes) at each grade level in General Chemistry, Organic Chemistry, Physical Chemistry and Industrial Chemistry Laboratories. The conducted informal observations were used to support the findings obtained from questionnaire.

Data analysis

The data obtained from the first part of the questionnaire were presented as frequency and percentages, and some data were presented as a table. Each question in the second part of the questionnaire is 5 points, the total score is between 0-30. Those whose scores are between 0-14.99 points were accepted unsuccessful, those whose scores are between 15-30 were successful. The data were compared in ANOVA in order to determine whether the scores of prospective teachers obtained from questionnaire differs in terms of grade level. Independent sample t test was applied to the data to determine whether the scores obtained from the questionnaire differed in terms of gender variable.

Results

In the first part of the survey used in the study, the evaluation which is carried out to determine ideas of prospective chemistry teachers about "laboratory safety" was made by considering the grade and gender variables.

Results from the First Part of Questionnaire According to the Grade Level

For the first question to determine the thoughts of prospective teachers on laboratory safety; 18 (95%) of the first grade prospective teachers, 10 (83%) of the 2nd grade prospective teachers, 12 (80%) of the 4th grade prospective teachers, 10 of the 5th grade prospective teachers stated that laboratory safety is important, however, 1 (5%) of the first grade prospective teachers, 2 (17%) of the 2nd grade prospective teachers, 3 (20%) of the 4th grade prospective teachers, 2 (17%) of the 5th grade prospective teachers stated that laboratory safety is not important.

For the second question to determine the information status of prospective teachers on laboratory safety; 9 of the first grade prospective teachers (47,3%), 1 of the second grade prospective teachers (8,3%), 2 of the fourth grade prospective teachers (13,3%) and 1 (8.3%) of 5. grade prospective teachers stated that they had no previous information about this topic. 3 (15.7%) of the first grade prospective teachers, 5 (41.6%) of the second grade prospective teachers, 9 (60%) of the fourth grade prospective teachers and 5 of the 5th grade prospective teachers, (41.6%) stated that they had some information about the topic. 6 (50.1%) of 4th grade prospective teachers, 4 (26.7%) of 4th grade prospective teachers, 6 of 6th grade prospective teachers, (50.1%) stated that they had already information about the topic (Table 1).

Table 1. *Distribution of frequency (f) and percentage (%) for the question about chemical laboratory safety information*

Information Status about Chemistry Laboratory								
	1. grade		2. grade		4. grade		5. grade	
	f	%	f	%	f	%	f	%
Have no previous information	9	47,3	1	8,3	2	13,3	1	8,3
Have some information	3	15,7	5	41,6	9	60	5	41,6
Have information	7	37	6	50,1	4	26,7	6	50,1
Total	19	100	12	100	15	100	12	100

For the third question which is asked in order to learn the thoughts of the prospective teachers about whether chemical substances used in the chemistry laboratory are harmful for human health, all of the 1st, 2nd, 4th and 5th grade prospective teachers stated that they were harmful.

When the fourth question of questionnaire which is "Must the information be given related to laboratory safety before starting chemistry laboratory applications" asked to prospective teachers; 16 (84.2%) of first grade prospective teachers said yes and 3 (15.8%) said no. 14 of the 4th grade prospective teachers (93.3%) said yes, while 1 (6.6%) said no. All of the 2nd and 5th grade prospective teachers said yes.

For the statement of fifth question which is "I think that everyone who attends the chemistry and the laboratory lesson must also learn the laboratory safety"; 18 (94.7%) of 1st grade prospective teachers said yes, and 1 (5.3%) said no. 14 of the 4th grade prospective teachers (93.3%) said yes, while 1 (6.6%) said no. All of second and fifth grade prospective teachers said yes.

For the statement of sixth question which is "The information of a teacher who teaches chemistry and lab is full as long as he knows the dangers in his profession"; Eight (42.1%) of the first grade prospective teachers agreed with this idea and 11 (57.9%) agreed with this idea partially. 4 (% 33,3) of 2nd grade prospective teachers stated that they agreed with this idea, 6 (50%) stated that they agreed partially and 2 (16,7%) stated that they did not agree. While 1 (6.6%) of the 4th grade prospective teachers indicated that they agreed with this opinion, 14 (93.4%) stated that they agreed partially. 3 of the 5th grade prospective teachers (25%) stated that they agreed with this idea and 9 (75%) stated that they agreed with this idea partially (Table 2).

Table 2. *Frequency (f) and percent (%) distribution for the statement of "The information of a teacher who teaches chemistry and lab is full as long as he knows the dangers in his profession."*

The information of a teacher who teaches chemistry and lab is full as long as he knows the dangers in his profession.								
	1. grade		2. grade		4. grade		5. grade	
	f	%	f	%	f	%	f	%
Agree	8	42,1	4	33,3	1	6,6	3	25
Partially Agree	11	57,9	6	50	14	93,4	9	75
Disagree	0	0	2	16,7	0	0	0	0
Total	19	100	12	100	15	100	12	100

For the statement of seventh question which is "The first step for ensuring safety in the chemistry laboratory is to get rid of the conditions that would cause health and cause accidents. For this, the teacher must have information"; while 10 (52.6%) of 1st grade prospective teachers expressed that they agreed with this idea, 8 (42.1%) expressed that they agreed partially and 1 (5.3%) did not agree. All of 2nd and 4th grade prospective teachers expressed that they agreed with this idea. 9 (75%) of the 5th grade prospective teachers expressed that they agreed, while 3 (25%) expressed that they partially agreed.

For the statement of eighth question which is "The teacher as well as the learners must have information about removing of causes of accidents that may occur in the chemistry laboratory"; while 16 (84.2%) of the first grade prospective teachers indicated that they agreed with this opinion, 1 (5.3%) stated that they partially agreed and 2 (10.5%) stated they did not agree. While 11 (92.6%) of the second grade prospective teachers indicated that they agreed with this opinion, 1 (8.4%) stated that they partially agreed. While 13 (87.6%) of the 4th grade prospective teachers indicated that they agreed with this opinion, 2 (13.4%) stated

that they partly agreed. While 11 (91.6%) of 5th grade prospective teachers indicated that they agreed with this opinion, 1 (8.4%) stated that they partially agreed.

Table 3. *Distribution of frequency (f) and percentage (%) for questions regarding the responsibilities of teachers and students on laboratory safety*

For which of the following procedures that are under the teacher's responsibility for laboratory safety, do students also need to take responsibility?		1. grade		2. grade		4. grade		5. grade	
		f	%	f	%	f	%	f	%
Communication	Yes	11	57,8	9	75	7	46,6	11	91,6
	No	8	42,2	3	25	8	53,4	1	8.4
Planned Action	Yes	9	47,3	12	100	9	60	6	50
	No	10	52,7	0	0	6	40	6	50
Safe Action	Yes	13	68,4	9	75	12	80	12	100
	No	6	31,6	3	25	3	20	0	0
Preparing laboratory use manual	Yes	11	57,9	5	41,6	9	60	8	33,3
	No	8	42,1	7	58,4	6	40	4	66,7
Creating checklist	Yes	6	31,5	5	41,6	6	40	5	53,8
	No	13	68,5	7	58,4	9	60	7	41,6
Total		19	100	12	100	15	100	12	100

For the ninth question of the questionnaire, "For which of the following procedures that are the teacher's responsibility on laboratory safety, do students also need to take responsibility?"; 11 (57.8%) of the first grade prospective teachers approved "Communication" case, 9 (47,3%) of them approved "Planned Action" case and 13 (68,4%) of them approved "Safe Action" case. 8 (42.1%) of first grade prospective teachers did not approve "preparation of laboratory use regulation" and 13 (%68,5) of them did not approve "Creating checklist" cases. "Communication" case was approved by 9 (75%) 2nd grade prospective teachers, "Planned action" case by 12 (100%) prospective teachers and "Safe Action" case by 9 (75%) prospective teachers. "The preparation of regulations to use laboratory" case was not approved by 7 (58.4%) prospective teachers and "Creating Checklist" case was not approved by 7 (58.4%) prospective teachers. "Communication" case was approved by 7 (46,6%) fourth grade prospective teachers, "Planned Action" case by 12 (60%) prospective teachers and "Safe Action" case by 9 (80%) prospective teachers. "The preparation of laboratory use regulations" case was not approved by 6 (40%) prospective teachers and "Creating Checklist" case was not approved by 9 (60%) prospective teachers. "Communication" case was approved by 11 (91,6%) fifth grade prospective teachers, "Planned Action" case by 6 (50%) prospective teachers and "Safe Action" case by 12 (100%) prospective teachers. "The preparation of laboratory use regulation" case was not approved by 4 (33,3%) prospective teachers and "Creating Checklist" case was not approved by 7 (58.3%) prospective teachers (Table 3).

For the tenth question, "Who prepares the laboratory safety checklist?", 2 (10.5%) of the first grade prospective teachers said that the student prepares, 9 (47.3%) of them said that teachers prepare and 2 (10.5%) of them said that principal prepares, 5 (26.3%) of them said that Ministry of National Education prepares and 1 (5.2%) of them marked "the other" option. 11 of the second grade prospective teachers (91.6%) said that the teacher prepares, 1 (8.3%) of them said that Ministry of Education prepares. While 7 (46.6%) of the 4th grade prospective teachers said that teachers prepare, 2 (13.4%) of them said principals prepare, 5

(33.3%) of them said Ministry of Education prepares, 1 (%6,6) of them marked "the other" option. While 7 (58.3%) of 5th grade prospective teachers said teachers prepare, 3 (25%) of them said that Ministry of Education prepares and 2 (16.6%) of them marked "the other" option (Table 4).

Table 4. *Frequency (f) and percentage (%) distribution related to the question of who prepare the laboratory safety checklist*

	Who prepare the laboratory safety checklist?							
	1. grade		2. grade		4. grade		5. grade	
	f	%	f	%	f	%	f	%
Teacher	9	47,4	11	91,6	7	46,6	7	58,4
Student	2	10,5	0	0	0	0	0	0
Principal	2	10,5	0	0	2	13,4	0	0
Ministry of Education	5	26,4	1	8.4	5	33,4	3	25
Other	1	5,2	0	0	1	6,6	2	16,6
Total	19	100	12	100	15	100	12	100

For the eleventh question which is asked to determine information status of prospective teachers on the warning and safety signs in terms of laboratory safety; While 3 (15.5%) of the first grade prospective teachers stated that they had a lot of information about the subject, 11 (57.8%) of them stated that they had partial information, 5 (26.4%) of them stated they had very little information. 3 (25%) of the 2nd grade prospective teachers stated that they had a lot of information about the subject, 7 (58.4%) of them stated that they had partial information and 2 (16.6%) of them said that they had very little information. While 1 (%, 6) of the 4th grade prospective teachers stated that they had a lot of information about the subject, 11 (73.3%) stated that they had partial information and 3 (% 20) stated that they had a little information. And 12 (100%) of 5th grade prospective teachers stated they had partial information.

For the twelfth question which is asked to determine information status of prospective teachers on first aid in terms of laboratory safety; While 1 (5.3%) of the first grade prospective teachers stated that they had a lot of information about the subject, 15 (79%) of them stated that they had partial information, 3 (25%) of them stated they had very little information. 3 (25%) of the 2nd grade prospective teachers stated that they had a lot of information about the subject, 7 (58.4%) of them stated that they had partial information and 2 (16.6%) of them said that they had very little information. While 1 (% 6,6) of the 4th grade prospective teachers stated that they had a lot of information about the subject, 11 (73.4%) stated that they had partial information and 3 (% 20) stated that they had a little information. 1 (% 8,3) of the 5th grade prospective teachers stated that they had a lot of information about the subject, 10 (83.4%) stated that they had partial information and 1 (% 8,3) stated that they had a little information.

Results from the Second Part of Questionnaire According to the Grade Level

The answers of chemistry prospective teachers to the first six questions which are asked in order to determine the "Chemical laboratory safety information level" and answers to the other six questions which are asked to determine "Laboratory warning and safety signs information level" and averages of scores they obtained are given in Table 5. When the scores obtained from these two information level forms are compared, It has been determined that

only the 1st and 5th grade prospective teachers' achievements are more than 50%. Second and fourth grade prospective teachers' achievements level is below 50%.

Table 5. *Frequency (f) and percentage (%) distribution for chemistry laboratory safety information level and laboratory warning and safety signs information level score*

Laboratory safety information level								
	1. grade		2. grade		4. grade		5. grade	
	f	%	f	%	f	%	f	%
0-14.99 Points (Failed)	6	31,6	7	58,3	11	73,3	1	8,3
15-30 Points (Successful)	13	68,4	5	41,7	4	26,7	11	91,7
Total	19	100	12	100	15	100	12	100
Average Score	**16,31**		**12,08**		**10,00**		**21,67**	
Laboratory warning and safety signs information level								
	1. grade		2. grade		4. grade		5. grade	
	f	%	f	%	f	%	f	%
0-14.99 Points (Failed)	14	73,7	9	75	15	100	9	75
15-30 Points (Successful)	5	26,3	3	25	0	0	3	25
Total	19	100	12	100	15	100	12	100
Average Score	**6,31**		**7,08**		**3,00**		**11,25**	

One-way ANOVA was applied to the data obtained from the questionnaire in order to determine whether there is a difference, in terms of grade level, between "laboratory safety information level" and "laboratory warning and safety signs information level". The results are presented in Table 6.

Table 6. *One-way ANOVA results obtained from the questionnaire according to the grade level variable*

	Squares sum	**df**	**Average square**	**F**	**p**
Between groups	2833,774	3	944,591	10,568	0,000
Inside groups	4826,571	54	89,381		
Total	7660,345	57			

It is seen in Table 6 that there is a statistically significant difference between the scores obtained from the questionnaire in terms of grade level variables ($F(3,57) = 10,568$, $p < 0,05$). As a result of the multiple comparison test (LSD test), the scores obtained from the questionnaire were determined that there are statistically significant differences in favor of the fifth grade when they were compared with the other grades; in favor of the first grade when they were compared with the fourth grades (Table 7).

Table 7. *Multiple comparison test (LSD test) results according to grade level*

Grades	**Average**	**Standard**	**p**

		difference	error	
1. grade	2. grade	3,465	3,486	0,753
	4. grade	10,489*	3,330	0,014
	5. grade	-9,676*	3,403	0,031
2. grade	1. grade	-3,465	3,486	0,753
	4. grade	7,024	3,719	0,245
	5. grade	-13,141*	3,785	0,005
4. grade	1. grade	-10,489*	3,330	0,014
	2. grade	-7,024	3,719	0,245
	5. grade	-20,165*	3,641	0,000
5. grade	1. grade	9,676*	3,403	0,031
	2. grade	13,141*	3,785	0,005
	4. grade	20,165*	3,641	0,000

* The average difference is 0.005 and it is at meaningful level.

Results from the First Part of Questionnaire According to Gender Variable

When a question is asked to prospective teachers in order to determine their ideas on laboratory safety; 28 (84.8%) of the female prospective teachers stated that laboratory safety was important, while 5 (15.2%) stated that it wasn't important. 22 (88%) of the male prospective teachers stated that laboratory safety was important, while 3 (12%) stated that it wasn't important.

For the question about determination of information status on laboratory safety; 9 (27.3%) of the female prospective teachers stated that they didn't have previous information about the subject, 11 (33.3%) stated that they had some information and 13 (39.4%) stated that they had previous information. 4 (16%) of the male prospective teachers stated that they didn't have previous information about the subject, 11 (44%) stated that they had some information and 10 (40%) stated that they had previous information (Table 8).

Table 8. *Distribution of frequency (f) and percentage (%) for the question about chemistry laboratory safety information*

Information Status about Chemistry Laboratory				
	Female		Male	
	f	%	f	%
No information before	9	27,3	4	16
Have some information	11	33,3	11	44
Have information	13	39,4	10	40
Total	33	100	25	100

For the question asked in order to learn the thoughts of the prospective teachers about whether chemical substances used in the chemistry laboratory are harmful for human health, all of the male (25) and female (33) prospective teachers stated that they were harmful.

For the question of "Should the information on laboratory safety be given before the chemistry laboratory practices start?", 30 (90.9%) of the female prospective teachers said yes and 3 (9.1%) said no. 24 (96%) of the male prospective teachers said yes, 1 (4%) said no.

For the statement of "I think that everybody who attends chemistry lessons and labs must learn laboratory safety rules", 32 (97%) of the female prospective teachers said yes, and 1 (3%) said no. 24 (96%) of the male prospective teachers said yes, 1 (4%) said no.

For the statement of "The knowledge of a teacher who teaches chemistry and lab is full, as long as he knows the dangers in his profession"; 11 (33%) of the female prospective teachers stated that they agreed, 20 (60.6%) stated that they partially agreed and 2 (6.1%) stated that they did not agree. 5 (% 20) of the male prospective teachers stated that they agreed this idea and 20 (80%) stated that they partially agreed (Table 9).

Table 9. *Frequency (f) and percent (%) distribution for the statement of "The information of a teacher who teaches chemistry and lab is full as long as he knows the dangers in his profession."*

The information of a teacher who teaches chemistry and lab is full as long as he knows the dangers in his profession.				
	Female		Male	
	f	%	f	%
Agree	11	33,3	5	20
Partially Agree	20	60,6	20	80
Disagree	2	6,1	0	0
Total	33	100	25	100

For the view of "The first step for ensuring safety in the chemistry laboratory is to get rid of the conditions that would cause health and cause accidents. For this, teachers must have information"; 27 (82%) of the female prospective teachers indicated that they agreed with this idea, while 6 (18%) stated that they partially agreed. 19 (76%) of the male prospective teachers indicated that they agreed with this idea, 5 (20%) stated that they partially agreed and 1 (4%) stated did not agree. For the view of "it is necessary for the student as well as the teacher to have information about removing the reasons of the accidents that may occur during lesson in the general chemistry laboratory" 31 (94%) of the female prospective teachers indicated that they agreed with this idea, 2 (6%) stated that they partially agreed. 20 (80%) of the male prospective teachers indicated that they agreed with this idea, 3 (12%) stated that they partially agreed and 2 (8%) stated thet did not agree.

Among the options which are given for the question of "For which of the following procedures that are the teacher's responsibility on laboratory safety, do students also need to take responsibility?"; 22 (66%) of the female prospective teachers approved "Communication" case, 23 (69,7%) of them approved "Planned Action" case and 25 (75,8%) of them approved "Safe Action" case. 11 (33,3%) of first grade prospective teachers did not approve "preparation of laboratory use regulation" case and 19 (57,5%) of them did not approve "Creating checklist" case. "Communication" case was approved by 16 (64%) male prospective teachers, "Planned Action" case by 14 (56%) prospective teachers and "Safe Action" case by 21 (84%) prospective teachers. "The preparation of regulations to use laboratory" case was not approved by 14 (56%) prospective teachers and "Creating Checklist" case was not approved by 18 (72%) prospective teachers (Table 10).

Table 10. *Distribution of frequency (f) and percentage (%) for questions regarding the responsibilities of teachers and students on laboratory safety*

For which of the following procedures that are under the teacher's responsibility for laboratory safety, do students also need to take responsibility?		Female		Male	
		f	%	f	%
Communication	Yes	22	66,6	16	64
	No	11	33,4	9	36
Planned Action	Yes	23	69,7	14	56
	No	10	30,3	11	44
Safe Action	Yes	25	75,8	21	84
	No	8	24,2	4	16
Preparation of laboratory use regulation	Yes	22	33,3	11	56
	No	11	66,7	14	44
Creating checklist	Yes	14	57,5	7	72
	No	19	42,5	18	28
Total		33	100	25	100

When the prospective chemistry teachers are asked "Who prepares the laboratory safety checklist?", 1 (3,1%) of the female prospective teachers said that the student prepares, 19 (57.5%) of them said that teachers prepare and 2 (6,1%) of them said that principal prepares, 9 (27.2%) of them said that Ministry of Education prepares and 1 (5.2%) of them marked "the other" option. 1 (4%) of the male prospective teachers said that the student prepares, 20 (60%) of them said that teachers prepare and 2 (8%) of them said that principal prepares, 5 (20%) of them said that Ministry of Education prepares and 2 (8%) of them marked "the other" option. (Table 11).

Table 11. *Frequency (f) and percentage (%) distribution related to the question of who prepare the laboratory safety checklist*

Who prepare the laboratory safety checklist?	Female		Male	
	f	%	f	%
Teacher	19	57,5	15	60
Student	1	3,1	1	4
Principal	2	6,1	2	8
Ministry of Education	9	27,2	5	20
Other	2	6,1	2	8
Total	33	100	25	100

When the prospective teachers are asked question about their information status on warning and safety signs in terms of laboratory safety; 3 (9,1%) of the female prospective teachers stated that they had a lot of information about the subject ,23 (69,7%) of them stated that they had partial information, 7 (21.2%) of them stated they had very little information. 4 (16%) of the male prospective teachers stated that they had a lot of information about the subject ,18 (72%) of them stated that they had partial information, 3 (12%) of them stated they had very little information. When the prospective teachers are asked question to determine their information status on first aid in terms of laboratory safety; 4 (12,1%) of the female prospective teachers stated that they had a lot of information about the subject ,23 (69,7%) of them stated that they had partial information, 6 (18.2%) of them stated they had very little information. 2 (8%) of the male prospective teachers stated that they had a lot of information about the subject ,20 (80%) of them stated that they had partial information, 3 (12%) of them stated they had very little information.

Findings Obtained from the Second Part of Questionnaire According to Gender Variable

The answers of the male and female chemistry prospective teachers to the first six questions asked in order to determine the "Chemical laboratory safety information level" and answers to the other six questions asked to determine "Laboratory warning and safety signs information level" and averages of scores they obtained are given in Table 12. When the scores obtained from these two information level forms are compared, it was seen that male and female prospective teachers obtained higher achievement in terms of "laboratory safety information level".

Table 12. *Frequency (f) and percentage (%) distribution for chemical laboratory safety information level and laboratory warning and safety signs information level score*

	Laboratory safety information level				**Laboratory warning and safety signs information level**			
	Female		Male		Female		Male	
	f	%	f	%	f	%	f	%
0-14.99 Points (Failed)	13	39,4	12	48	27	81,9	20	80
15-30 Points (Successful)	20	60,6	13	52	6	18,1	5	20
Total	33	100	25	100	33	100	25	100
Average Points	**14,70**		**15,40**		**6,81**		**6,40**	

Independent sample t-test was applied to the data to determine whether there is difference between the scores obtained from the "laboratory safety information level" and "laboratory warning and safety signs information level" in terms of gender variable. The obtained results are given in Table 13.

Table 13. *Independent sample t test results which are applied to the scores obtained from the questionnaire according to gender variable*

Gender	N	Average	Standard deviation	Degree of freedom	t	p
Female	33	20,91	11,282	56	0,231	0, 880
Male	25	21,60	11,247			

When the results obtained from Table 13 are examined, according to the gender variable, it is seen that there is no statistically significant difference between the scores obtained from the questionnaire ($t = 0,231$, $p > 0,05$).

Discussion Conclusions and Recommendations

When the results obtained from the first part of the questionnaire are examined both in terms of grade level and gender, the results show that prospective chemistry teachers are aware of the importance of safety. They expressed that everyone who participates in the laboratory works must have information related to the safety and laboratory warnings and safety signs. Although the questionnaire findings show that prospective chemistry teachers are aware of the importance of safety issues, the results of informal observation showed that prospective teachers, even the instuctor, did not work in the fume cupboard when working with some volatile substances, they poured all the chemical wastes into sinks and did not check the warning signs on the tubes.

The results obtained from the second part of the questionnaire revealed that the prospective teachers do not have sufficient information about the subject. In terms of grade level, according to the scores obtained from the "Chemistry laboratory safety information level", 31.6% of first grade prospective teachers, 58.3% of second grade prospective teachers and 73.3% of third grade prospective teachers failed. 68.4% of first grade prospective teachers, 41.7% of second grade prospective teachers, 26.7% of fourth grade prospective teachers and 91.7% of fifth grade prospective teachers were successful. This situation shows that the information levels and security-related information of the prospective teachers, except the 5th class prospective teachers, are not sufficient. Similar findings were reported in studies carried out by Morgil and Yılmaz (2000), Kırbaşlar, Özsoy Güneş and Derelioğlu (2010). This study has reached the conclusion that, university students, regardless of their grades, should be given preliminary information on how to carry out experiments safely when starting laboratory applications.

The reason for the achievements of fifth grade prospective teachers related to the laboratory safety information level may be due to the fact that they have been attending lab courses for many years and accordingly they have gained more experience in this regard and have become closer to be teachers. The fact that fourth grade students focus on laboratory courses all the time as well as intensive course programs may have reduced their interest in the laboratory and may have led them to be more uninterested to laboratory safety. The fact that second graders take laboratory technique and safety lesson in that term can explain why they are more successful than the first and fourth grade prospective teachers. The fact that first grade students don't have knowledge about the subject, that they have not taken this class yet and that the questionnaire was carried out in exam week of the fourth grade students may be some of the reasons for success differences.

When the data obtained from the second part of the questionnaire are examined, taking into consideration the gender variable; according to the scores obtained from "Chemistry laboratory security information level", it is seen that 39.4% of the female prospective teachers were unsuccessful, 60.6% were successful; 48% of the male prospective teachers were unsuccessful and 52% were successful (Table 12). When we look at the percentages, it is seen that the female prospective teachers are more successful than the male prospective teachers, but there is no statistically significant difference between them ($t = 0{,}231$, $p > 0{,}05$, Table 13). It can be said that the male and female prospective teachers' preliminary information related to the laboratory safety is close to each other. In the conducted in-laboratory informal observations, it has been observed that prospective teachers of both genders generally exhibited the same behaviors. Similarly, Semerci (2001), Böyük, Demir and Erol (2010), Türk (2010) conducted studies with Science and Technology teachers, in their studies, they have reported that there is no difference in proficiency opinions related to laboratory studies in terms of their genders.

When the data obtained from the "Laboratory warning and safety information level" in the second part of the questionnaire are analyzed by considering both the grade level and gender variable, it is seen that the achievement is very low (Tables 5 and 12). There are differences between the answers of the prospective teachers they gave in the first stage of the questionnaire and the scores they received in the second stage of the questionnaire. While the majority of the chemistry prospective teachers (70.6%) indicated that they had partial information about warning and safety signs in terms of laboratory safety, it was determined that 47 of 58 chemistry prospective teachers failed in terms of laboratory warnings and safety signs information level, and 11 of them were successful. Conducted informal observations also support this result. Because, it has been observed that prospective chemistry teachers

have poured all the chemical wastes into sinks and did not check the warning signs on the tubes. In a similar study conducted with university students and laboratory staff, some chemicals and safety signs were given to those persons and they were asked to match signs with chemicals, and it was reported that they could not demonstrate sufficient success at the end of work (Karapantsios, Boutskou, Touliopoulou and Mavros, 2008). In a study conducted by Böyük, Demir and Erol (2010), it has been determined that science and technology teachers have deficiencies in following the safety rules when using new tools and equipments.

In conclusion, this study reveals that the learned information remains in theory and that practical application is not taken into sufficient consideration. For this reason, when necessary, it is suggested to give information about the safety in the laboratory lessons, to remind them and to spare time to give safety information in the theoretical lessons. It should be emphasized that the safety information taught to prospective teachers is not limited to the laboratory and that this information is also important in daily life. In this way, their desires and interests to learn the security issue can increase, and the learned information may become more meaningful. Furthermore, the fact that the labels on the chemicals are rearranged in a more understandable, more noticeable manner and that the necessary explanations are in the users' own language can contribute to the laboratory safety issue.

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