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An action research to overcome undergraduates' laboratory anxiety

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Abstract

In this study, it was aimed to determine and overcome undergraduates' laboratory anxiety. For this purpose, Laboratory Anxiety Questionnaire (LAQ) was developed by researchers. LAQ was applied to 92 undergraduates as a pre-test and focus group interviews were performed to determine their laboratory anxiety. An action research was conducted by researchers. After instruction was accomplished in ten weeks, LAQ was applied as post-test. According to results, it was found that undergraduates' laboratory anxiety related to working chemicals especially acids, using laboratory materials and equipments, laboratory accidents and making mistake, which were determined in the pre-test, were overcome in highly percentages.

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1. Introduction

The laboratory has been given a central and distinctive role in science education, and science educators have suggested that rich benefits in learning accrue from using laboratory activities (Hofstein & Lunetta, 2004). Laboratory settings provide observe scientific events, promoting conceptual understanding and conceptual change (Costu, Ayas& Niaz, 2010), develop scientific research skills, promoting perception of science and generate various learning environment (Can, 2013). Students enjoy laboratory work and that laboratory experiences resulted in positive and improved student attitudes and interest in science (Hofstein, 2004). Laboratory is effective instructional method for promoting interest in chemistry studies (Ben-Zvi et al, 1976) and motivating students to learn science (Freedman, 1997; Thompson & Soyibo, 2002). Moreover, laboratory activities have the potential to

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enhance constructive social relationships as well as positive attitudes and cognitive growth (Hofstein & Lunetta, 1982; Lazarowitz & Tamir, 1994).

Although learning is restricted to its cognitive dimension in general, affective and experimental dimensions affect directly laboratory applications (Mintzes, Wandersee & Novak, 1998). There is a significant correlation between affective features and success (Bloom, 1979) and students' positive or negative feelings affect students' laboratory performance (Eddy, 2000; Wynstra & Cummings, 1993). One of these negative feelings is laboratory anxiety. In the literature, although there are many researches about science and chemistry anxiety (Czerniak & Charelott, 1984; Eddy, 2000; Huey, 2013; Kurbanoglu & Akim, 2012; Laukenmann et al., 2003; Mallow & Greenburg, 1983; Matyas, 1984; Okebukola & Jegede, 1989; Oludipe & Awokoy, 2010; McCarthy & Widanski, 2009; Woldeamanuel et al., 2013; Wynstra & Cummings, 1990), determining laboratory anxiety (Anılan et al., 2009; Bowen, 1999; Eddy, 2000; Kurbanoglu & Akim, 2010; Malakpa et al., 2013), there has been a lack of research about overcoming laboratory anxiety (Alkan & Erdem, 2013; Can, 2013; Erökten, 2010; Toprak & Çelikler, 2011). Alkan & Erdem (2013) determined the effect of self directed learning on student's success, self-directed learning readiness in laboratory, attitudes towards laboratory skills and chemistry laboratory anxiety in chemistry laboratory. They planned self directed learning in laboratory according to the process of project based learning. The results of this research showed that self-directed learning in laboratory has a meaningful contribution to promoting chemistry success, self-directed learning readiness in laboratory and overcoming students' chemistry laboratory anxiety. Can (2013) investigated change of student's anxiety after activities to be performed within the framework of General Chemistry Laboratory Course. She found that a meaningful decrease in anxiety levels after the instructions. Similarly, Erökten (2010) searched the effect of laboratory application on pre-service science teachers' chemistry laboratory anxiety and she determined decrease in anxiety. It is important to overcome students' laboratory anxiety for an effective laboratory instruction. Toprak & Çelikler (2011) used 3E and 5E learning cycle and they found considerable reduction on anxiety levels between pre-test and post-test. For this reason, there is a need of construction application like action research design should be used in an effort to overcome anxiety.

Action research is a systematic, reflective and collaborative inquiry (Uzuner, 2005). This approach provides gather information to enhance instructions. Action research, which has been a frequently used research method recently, is considered a fruitful research approach used by academicians and teachers to obtain systematic and scholarly information, and to develop current applications in different fields of education (Kuzu, 2009). Action research is aimed to comprehend instructional process and develop it. It provides that suggest a solution for problems occur during instruction, conduct a plan and observe researchers' own applications.

2. Method

2.1. Purpose of the research

The purpose of this study was to determined and overcome undergraduates' laboratory anxiety.

2.2. Participants

The participants were ninety-two first grade undergraduate students (19 years of aged) in a university in Turkey. They randomly assigned to the sixteen groups (twelve of them with six students and four of them with five students) for activities according to their score of university entrance examination and social abilities determined according to the interviews with them.

2.3. Instrument

In this study, Laboratory Anxiety Questionnaire (LAQ) was developed by researchers. For this purpose, 40 undergraduates were required to list their laboratory anxiety.

According to their high frequencies responses and literature review (Anılan et al., 2009; Azizoğlu & Uzuntiryaki, 2006; Bowen, 1999; Eddy, 2000; Kurbanoglu & Akim, 2010; Malakpa et al., 2013) LAQ including four items were developed. The items were related to anxiety about using chemicals (5 options), laboratory materials and equipments

(6 options), laboratory accidents (4 options) and making mistake during experimental process (5 options). Students could chose more than one options and each items included a "none" option.

2.4. Procedures

This study conducted to performing an action research in order to determine and overcome students' laboratory anxiety. An action research plan designed following steps.

- Data collection for determine problem
- Data analyses
- Development an action research plan for solution of problem
- Activities applications.
- Data analyses.

LAQ was applied to 92 undergraduates as a pre-test and focus group interviews were performed to determine their laboratory anxiety. According to pre-test and focus group interviews' results, an action research was planned. This action research included these activities:

- Give information about laboratory safety and applications
- Give information about laboratory rules and applications.
- Give information about providing against laboratory accidents and applications
- Give information about first aid for laboratory accidents and applications
- Give information about chemicals and safety symbols
- Give information about laboratory materials and equipments and application them by students.
- Give information about sources of experimental errors
- Perform experiment about preparing strong acid-base solutions
- Perform experiment about reactions strong acid-base solutions
- Scientific excursion to hospital laboratory

During this process, information about aforementioned subjects was given to undergraduates, brainstorming sessions were conducted. In addition these, some applications were conducted using demonstration, showing and practicing and group work methods. Experiments related to strong acids and bases were performed by reason students have anxiety about these chemical which were determined in the pre-test and focus group interviews. Scientific excursion was conducted to hospital laboratory by researcher to overcome infection from sample and materials. After the instruction was accomplished in ten weeks, LAQ was applied as post-test.

3. Results

In order to identify students' laboratory anxiety, LAQ was applied as pre-test and post-test. Students responses listed, frequencies and percentages were calculated (Table 1).

According to results, anxieties which were determined in the pre-test were overcome in highly percentage. Frequency of "none" response increased all of items. Percentage of "poisoning from chemicals or their vapor" options decreased from 53% to 10% and this anxiety is the most decrease in the all of anxiety.

4. Discussion

The present study was an investigation of determining and overcoming undergraduates' laboratory anxiety. Pre-test results showed that students' laboratory anxieties were related to using chemicals, working with laboratory materials and equipments, laboratory accidents and making mistake during experimental process. According to pre-test results, students have anxiety about working chemical in highly percentages. Similarly, "*students feel restless while they using chemicals at first*" indicated in the previous studies (Alkan & Erdem 2013; Anılan et al., 2009; Can, 2013; Erökten, 2010, Kurbanoğlu & Akim, 2010; Toprak & Çelikler, 2011). Moreover, Breslow (1993) defined chemistry anxiety as a fear of chemical substances and Eddy (2000) underlined that chemistry anxiety analyzed under three heading and anxiety of chemical substances is one of them.

Table 1. Results of LAQ

Item	Anxieties in options	Pre-test		Post-test	
		Frequency	Percentage	Frequency	Percentage
1	Splashing a strong acid on my hand, face etc.	66	72	31	34
	Dumping expensive chemicals	30	33	17	19
	Poisoning from chemicals and their vapor	35	53	9	10
	Flammable chemicals	32	35	17	19
	None	13	14	39	42
2	Breaking to glass material	24	26	12	13
	Dirty glass materials	11	12	10	11
	Breaking to expensive equipments	37	40	21	23
	Not having enough information about the use of equipments	28	30	9	10
	Cutting and piercing materials	23	25	14	15
3	None	19	21	48	52
	Safety precautions aren't taken sufficiently	24	26	8	9
	Fire or gas leak	37	40	20	22
	Electric leak on equipments	42	46	18	20
4	None	24	26	58	63
	Infection from samples and materials	48	52	18	20
	Make mistake during experiment	27	29	11	12
	To hurt to somebody or me because my mistake	63	69	37	40
	Wrong evaluation to experiment results	30	33	12	13
	None	9	10	37	40

Overcoming laboratory anxiety provides that learning complex laboratory task, promoting problem solving skills, self efficiency and development positive attitude toward chemistry (Kurbanoğlu & Akim, 2010). For this reason, it is important to overcome students' anxiety with different learning environments. Anılan, Görgülü & Balbağ (2009) found that pre service science teachers' anxiety about using laboratory time decreased when laboratory application progressed. Similarly, Erökten (2010) emphasized that students' anxiety overcame with experiments and spending more time. Can (2013), establish that experiments in the context General Chemistry Laboratory were effective to overcome anxiety. In addition to these, self-directed learning in laboratory has a meaningful contribution to reduction chemistry laboratory anxiety of students (Alkan & Erdem 2013). The results of this study showed that action research that applied in this study is very effective to overcome undergraduates' laboratory anxiety. According to findings undergraduates' laboratory anxiety related to working chemicals especially strong acids, using laboratory materials and equipments, laboratory accidents and making mistake, which were determined in the pre-test, were overcome in highly percentages. Action research is very effective for promoting educational process as indicated in the previous studies by Aksoy (2003), Lundeberg et al. (2003) Manfra (2009), Yaman and Karaaslan (2012). In conclusion, the obtained results from this study showed that undergraduates have many laboratory anxiety and action research that applied in this study provide to overcome undergraduates' laboratory anxiety. For this reason, it is crucial to develop, generalized and apply different learning environment like this study.

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