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Evaluating the Effectiveness of Laboratory Attitudes of Science Teacher Candidates on their Argument Create Skills

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Abstract

The aim of this study is to investigate the relationship between science teacher candidates' ability to construct an argument and their science laboratory attitudes. For this purpose, an argumentation based science laboratory has been applied to first year science teachers. An argument-based science learning report which was developed by using rubrics was used to determine pre-service teachers' argument create skills. The arguments they made were evaluated by 8 teaching staff and PhD students as the quality of the arguments and descriptions they used in the reports and the total writing scores. The 'Science Laboratory Attitude Scale' was applied in order to determine the relationship between pre-service teachers' argumentation skills and science laboratory attitudes. The analyses of the data were made by using the SPSS 21.0 Statistical Program. The findings shows that there is a significant relationship between their argument create skills and laboratory attitudes.

Keywords: Argument Create Skills, Science Laboratory Attitudes, Science Education, Science Teacher Candidates

1. Introduction

When studies in the field of science education have been examined in recent years, it is observed that the argumentation method has been focused on. Argumentation has been addressed by Toulmin (1964) for the first time. Toulmin (1964) stated that scientists have used arguments to combine evidence with their support and reasons, and mentioned the six elements of the argument. Toulmin's argument model, is a model which addresses the structure of an argument in terms of its interconnected elements; from a claim, to evidence that supports this claim, the reasons that indicate the relationship between the evidence and the claim, the support that strengthens the grounds (from the preliminary information), the qualifiers (from the delimiters), and finally consisting of the refutations pointing to the situation or events where the assertion is void (Erduran, Simon & Osborne, 2004; Aydin & Kaptan, 2014).

In the literature the definitions made by various researchers of argumentation can be evaluated in terms of concepts, such as, product-process, individual-social, oral-written and dialogue-

ISSN
2822-6844

single personality. Given the definitions made by various authors, argumentation can be defined as the process of attempting to convince the opposite side of an idea that an individual or group holds, by using structured scientific evidence (Aydin & Kaptan, 2014).

In the world, argumentation is used more frequently in science education than in other areas. In the classes it has been applied, it has been found that students have increased their academic achievements and developed their critical thinking, problem solving, decision-making skills and that the argumentation process has influenced peer-teaching (Felton &

Kuhn, 2011; Gillies & Khan, 2009; Nussbaum, 2011; Chen & She, 2012; Torun & Sahin, 2016; Authors, 2017).

In the science curriculum, laboratory activities have a long-lasting importance. The benefits of students in science laboratory activities and science education are indicated by numerous researchers (Pickering, 1980; Hofstein & Lunetta, 1982; Garnet et al., 1995; Lunetta, 1998; Tobin, 1990; Hofstein & Lunetta, 2003; Morgil, 2009).

There are many scientific teaching methods that can be applied in science teaching. The laboratory method is one of the most common among these methods. The laboratory is an environment in which the student can learn a topic that is intended to be taught directly by himself by doing, or by the demonstration technique (Yilmaz & Morgil, 1999).

The laboratory method aims to teach by proving the fundamental knowledge of science by way of experimentation. In addition, this method has many positive effects, such as critical thinking of students, reasoning and improving problem solving skills. Therefore, laboratory applications are an integral part of science education and is its focal point (Ozdogan et al. 2003).

Appropriate laboratory activities are effective in the development of students' research, problem solving and reasoning skills. For example, these activities can help students in understanding the skills of dexterity, observation-based ability and scientific concepts. The student can develop positive behaviors that improve student success by strengthening communication and cooperation. The effectiveness of science laboratory applications has the effect of the laboratory environment and student dependent variables. The studies carried out point to the important variables in the laboratory environment as teacher attitudes and behaviors, the content of laboratory activities, teaching objectives, laboratory management and learning environment (Hofstein & Lunetta, 1982; Transmitted: Ulucinar et al. 2004).

In order for better teaching-learning quality, teachers have to be at the highest level of both their attitudes towards the method and their information. The fundamental sciences contributing to the development of technology are sub-branches of the science area, such as physics, chemistry and biology. Therefore, especially in undergraduate education, students should be familiar with the new methods as well as their attitudes towards the science laboratory being at a high level (Demirci, 1993).

The most important of the conditions of quality in education is attitude. There is no mention of success in teaching activities where student attitudes are ignored. Some of the sensory behaviors aimed at education are directly related to attitudes. As attitudes constitute the most important group that determines the individual's behaviour, students are targeted to develop positive and healthy attitudes towards various elements of our culture, various institutions of our society and other groups in the vicinity. It is possible to know the extent to which these objectives have developed by measuring the attitudes believed to have evolved (Oruc, 1993).

ISSN
2822-6844

2. Method

In this study a semi-experimental method and screening method, which is a type of experimental research in quantitative research methodology, has been used. The research population are 1st year students from Inonu University, Faculty of Education and Science Teaching. The study was done on 48 students in 1st year at Inonu University, Faculty of Education, Science Teaching Program.

To determine the argument formation skills of pre-service teachers, the arguments they created were analysed by 8 lecturers and doctoral students applying the ATPPC report rubric used in the work of Choi (2008) where the quality of the arguments and descriptions used by the students in the reports were evaluated as total writing scores.

To determine the laboratory attitudes of pre-service teachers, the 'Attitude Scale Towards Science Laboratory ' developed by Yamak et al. (2012) was used. The Scale consists of 23 items with three factors (Table 1).

Table 1. Attitude Scale Subgroups

Sub-Groups	Item Count
Importance of Laboratory (Factor 1)	9
Laboratory Lesson and Usage of Tools (Factor 2)	8
Laboratory Documents (Factor 3)	6

3. Findings

In this work, where the pre-service teachers' argument create skills were evaluated, it was aimed to evaluate the existing arguments about acid-bases, to create arguments and to form counter arguments against existing arguments.

Activity 1

It was asked to pre-service teachers to evaluate an existing claim about global warming and support this claim with data. They were asked to score between 1 and 3 according to whether they participated in the evaluation or not. The following scale was used when this activity was scored (Table 2).

Table 2. Activity 1 Evaluation Scale

Criterion	Score
Only Estimation	1
Using Data	2
Data and Rationale	3

The highest score is 15 because there are 5 expressions in total. The average of the first event is 6.91. It is seen that pre-service teachers are able to evaluate the claims of the prospective teachers and support them at least in some cases.

Activity 2

In this activity, they were asked to evaluate and indicate the cause of an existing claim about the effects of acids on human health. The following scale was used when this activity was scored (Table 3).

Table 3. Activity 2 Evaluation Scale

Criterion	Score
Only Estimation	1
Using Data	2
Data and Rationale	3

The highest score is 9 because there are 3 expressions in total. The average of the first event is 2.87. This indicates that teachers are in the evaluation stage.

Activity 3

In this activity, it requested to create claims about the effects of acids on human health and to support these claims with data. The difference between this activity and the other activities is that the pre-service teachers need to create and justify their own claims in the given issue. The following scale was used when this activity was scored (Table 4).

Table 4. Activity 3 Evaluation Scale

Criterion	Score
No Specific Claim	1
Specific Claim	2
Claim + Data	3
Claim + Data + Rationale	4
Claim + Data + Rationale + Supporting	5

The highest score is 5 in this activity. The average of the first event is 1.12. This indicates that pre-service teachers can only create claims in a particular context, but can not pass on the data phase.

Activity 4

In this activity, there are 5 different expressions for evaluating the claims about acid-bases. When one of these statements is evaluating, it is necessary to make a counter argument. The following scale was used when this activity was scored (Table 5).

Table 5. Activity 4 Evaluation Scale

Criterion	Score
Using Only Data	1
Data + Rationale	2
Data + Rationale + Supporting	3
Counter Claim + Data	4
Counter Claim + Data + Supporting	5

ISSN
2822-6844

The highest score to be awarded in the event is 17. The average of this activity is 7.62. This suggests that the pre-service teachers can often use data to support their existing claims.

The Laboratory Attitudes of Pre-Service Science Teachers

In order to determine the learning approaches of pre-service science teachers, the averages and standard deviations of the scores of the LAS' subscales were calculated. A t-test was conducted to determine whether the difference between the averages was significant. The results of the analysis are given in Table 6.

Table 6. The arithmetic mean, standard deviation results of the LAS subscale scores of pre-service science teachers

Subscales	n	A	SD
Factor 1	46	4,45	0,43
Factor 2	46	4,31	0,57
Factor 3	46	3,52	0,61

When Table 6 is examined, it is seen that the average of the pre-service science teacher for the importance of laboratory (4.45) is higher than the laboratory lesson-usage of tools (4.31) and the lab documents (3.52).

According to the t-test results, the difference between the averages of factor 1 and factor 3, compared with factor 2 and factor 3 was significant ($p<0,05$) (Table 7). Table 7 shows the t-test results of the subgroups of the laboratory attitudes. According to the results, there is a significant relationship between first and the third subgroups ($p<0.001$) and there is also a significant relationship between the second and third subgroups ($p<0.001$). However, we could not find a significant relationship between the first and second subgroups.

Tablo 7. t-Test Results of the LAS Subscales

	t-value	Significance
Factor 1 & Factor 2	1.335	0.191
Factor 1 & Factor 3	8.912	0.000
Factor 2 & Factor 3	6.453	0.000

As shown in Table 8, the relationship between the importance of laboratory for pre-service science teachers and their ability to create an argument is positive, and the correlation coefficient is $r = 0.462$. The calculated correlation coefficient was found to be significant at $\alpha = 0.001$ level. The relationship between the laboratory lesson-usage of the tools, attitudes and their argument creating skills is positive and the correlation coefficient is $r = 0.433$ ($\alpha=0.009$). The relationship between attitudes and interests towards laboratory documents and their argument creating skills is positive and the correlation coefficient is $r = 0.457$ ($\alpha=0.006$).

Table 8. Relationship between Argument Create Skills and Science Laboratory Attitudes

	Argument Creation Skills (ACS)	LAS Factor 1 (F1)	LAS Factor 2 (F2)	LAS Factor 3 (F3)
ACS -Pearson Correlation Coefficient	1,00	0,462**	0,433**	0,457**
Level of Significance	-	0,001	0,009	0,006
n	46	46	46	46
F1 – Pearson Correlation Coefficient	0,462**	1,00	0,455**	0,446**
Level of Significance	0,001	-	0,006	0,007
n	46	46	46	46
F2 - Pearson Correlation Coefficient	0,433**	0,455**	1,00	0,302
Level of Significance	0,009	0,006	-	0,078
n	46	46	46	46
F3 - Pearson Correlation Coefficient	0,457**	0,446**	0,302	1,00
Level of Significance	0,006	0,007	0,078	-
n	46	46	46	46

4. Discussion

In recent years, the rapid developments in science and technology have made it imperative to use new methods in science education. In order to catch up to the developed countries in education, some changes have been made in the science program. In this context, from 2013 onwards, research and inquiry-based learning has been incorporated into the science program (Chairmanship of the Training Board, 2005, 2006, 2013). In the implementation of these changes in the program, teachers of science play the lead role.

In the contemporary education system it is essential that individuals grow as individuals, who do not have standard thinking patterns, who know science concepts, who have scientific thinking, who have the ability to think analytically, and who can identify inter-concept relationships (Kirikkaya, 2010; Demirel, 2015).

Effective science education may occur in a classroom environment where students can express their thoughts without hesitation, make their ideas and claims with evidence, and establish opposing arguments in order to refute the claims of their friends (Kaya & Kilic, 2010).

Some of the sensory behaviors aimed at education are directly related to attitudes. As attitudes constitute the most important group that determines one's behaviour, students are targeted to develop positive and healthy attitudes towards various elements of our culture, various

ISSN
2822-6844

institutions of our society and other groups in the vicinity (Hancer et al. 2007).

A reaction that an individual has against any subject, the attitude that expresses the predisposition is a phenomenon that leads to the behaviour of the individual and causes bias in the decision making process. The attitudes of the individual are invisible, however, you can be informed of his attitude towards an object by his actions (Morgan, 1991; Nuhoglu, 2008).

Measuring attitudes in the training and teaching process, predicting their future behaviour by determining the attitudes of learning in a certain time unit, determining their attitudes about the conditions they are in, changing attitudes, or new attitudes or to learn the current preferences of learners, are all useful perspectives which provide benefits (Nuhoglu, 2008).

5. Conclusion

It is known that the laboratory is very important in science teaching. In this context, it is important that science teachers have a good laboratory education and that their laboratory interests and attitudes are at a high level. It is obvious that science teachers can effectively use the laboratory, as well as the need to be open and able to use new methods used in science teaching. In light of these facts, we have compared the attitudes of pre-service science teachers to the skills of establishing arguments and their laboratory classes. According to the results of the analysis we obtained from the data, there was a strong positive correlation between pre-service teachers' ability to create arguments and establish laboratory attitudes. The correlation between the skills of establishing arguments and the importance of the laboratory is higher than the other sub-factors ($r = 0.001$).

Classroom environments where students can express their opinions freely, support their thoughts and allegations with evidence, and disprove opposing opinions with arguments, are the environments where an effective science education can take place (Kaya & Kilic, 2010; Demirel, 2015). This training environment should be supported by effective laboratory training. In this direction, we will be the science educators of the future, the science pre-service teachers who will teach young minds by encouraging the love of science, laboratory attitudes and the ability to establish arguments should be supported.

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