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Examination of Natural Science Laboratory Perception Levels of Students at Primary Education Grade 6 and Their Attitudes Towards Laboratory Practices of Natural Science Course

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Abstract: Attitude is the positive or negative tendency of an individual to any matter. Attitude towards natural science is the emotions, thoughts and behaviors of individuals towards natural science and concepts of natural science. These emotions, thoughts and behaviors may be positive or negative and vary in time. Attitude is influenced by many variables such as age, gender, home and school media, teacher's personality and instruction technique, previous knowledge and experience, and the attitudes and behaviors of parents. However, the studies performed state that attitude towards natural science is influenced most by laboratory studies. Laboratories are not only places, where students learn theoretical information, but also practices, with which they understand scientific methodology, can behave like a scientist, and develop their practical abilities. Laboratories are media where students work alone or in small groups in cooperation and investigate and examine scientific events. Laboratory studies are carried out in order to verify in laboratory medium the concepts, principles, theories, laws and etc. presented in relation to natural science, to recognize laboratory tools and materials and to gain the skills of using them and establishing an experiment mechanism. There are studies which advocate that laboratory activities develop social relationships and help cognitive development by forming a positive attitude.

This study examined whether there was any difference in the attitudes of students at primary education grade 6, who received natural science education in the laboratory and in classroom, towards the laboratory practices of natural science course and in their laboratory perceptions. In this line, the relational model based only on post-test control group was used some 86 students (42 in the experiment group and 44 in the control group) in total constituted the study group. "Attitude Scale for Laboratory Practices of Natural Science Course" and the drawings regarding the laboratory media, which students imagined to have during the practices of natural science course, were used as data collection instruments. Descriptive statistics was used for determining the attitudes of students towards the laboratory practices of natural science course and the difference in their laboratory perceptions. T-test was used so as to find out whether they differed in terms of the specified variables. As a result of the analysis, a significant difference was found in the attitudes of students, who received natural science education in laboratory and in classroom, towards the laboratory practices of natural science course and in their laboratory perceptions.

Keywords: *Science Education, Natural Science Laboratory, Laboratory Perception, Attitude*

Introduction

People are born with many requirements and they turn their steps towards nature to meet these requirements. This kind of tendency which aims at benefiting from any kind of opportunities of the nature has brought about various sciences. Natural science is one of the most important sciences (Yesilyurt, 2005). The most **important** feature that distinguishes natural science from other sciences is that it places emphasis on experiment and observation. Individuals learning by experimenting, seeing, searching, examining and discussing will have different attitudes and actions towards things than individuals raised with classic methods. Laboratories are indispensable parts of secondary school natural science education. Because laboratories are more valuable and more motivational places in terms of natural science education in school. Thanks to these places, students can achieve more satisfying and more defensible objectives (Braund & Reiss, 2006). Natural Science Laboratory is a place where subject or concept to be taught is transferred to the student with experience or demonstration. (Taskin, Ekici, & Taşkın, 2002). Laboratories are places where students can acquire chance to put into practice what they have learned in theoretical classes, gain experience at first hand and where generally such techniques as observation, experiment and learning by doing and by experience are used and individual and group works are utilized in specially equipped applied classes. (Doğdu & Arslan, 1990; Özmen, 2001). Laboratory has a different and distinct role for natural science education. Natural science educators claim that the use of laboratory activities yields prolific results for learning. Because laboratory activities have as much special potential as media which encourages students to learn natural science and make a production (Hofstein & Lunetta, 2003). Therefore students acquiring laboratory techniques and skills can use these qualifications for new situations. This enables students to understand that knowing is only possible through science and natural science and this makes them a part of the scientific process (Tweedy & Hoese, 2005).

Laboratory medium should be a place where student solidarity is rendered possible, rules indicated are obeyed, classroom environment can become integrated when necessary, open ended experiments based on discovering are conducted and equipments and materials are adequate. These kinds of laboratory mediums are not only places that develop students' learning process but they also create positive impact on their academic achievement (Aladejana & Aderibigbe, 2007). What is more, they provide students with different learning environments develop their communicating skills, enable students to make necessary researches by creating productive learning environment and therefore influence their perceptions about learning (Orion, Hofstein, Tamir, & Giddings, 1997).

Laboratory method is a way that students follow on their learning process in laboratory or in private classrooms with such techniques as observation, experiment, learning by doing and by experience and demonstration in the form of individual or group activities (Alicıgüzel, 1979). Laboratory method has an important place in that it enables students to learn natural science concepts, which are abstract to many, more effectively and more meaningfully.

Laboratory method creates thought system based on observation and experiment in student's mind, makes students more active during their learning process, and hence leads them to creative thinking by increasing their desire and interest towards research (Karamustafaoglu, 2000).

A well-designed laboratory teaching should have a search purpose and should be activity based so that students' understanding level can be improved. Research type experiences should improve students' qualifications. But teachers do not follow research methods in the laboratories (Mckee, Williamson, & Ruebush, 2007).

Students pay more attention to student collaboration, activities based on research, open-endedness and commitment to rules in a laboratory medium. Teachers, on the other hand, are more likely to pay attention to equipments and materials that need to be in a laboratory (Tsai, 2003). Use of laboratory for a good natural science teaching has been proven to be useful by researches. What is more, it was concluded that information given regarding laboratories are of great importance in terms of effective laboratory utilization (Uluçınar, Cansaran, & Karaca, 2004).

Lunetta (1998) explained the objectives of laboratory studies as follows:

- Providing students with theoretical and conceptual information while learning natural science.
- Enabling students to learn natural science by helping them understand methods and nature of science.
- Enabling students to do science using scientific research procedures.
- Supporting students in a way that will help them define and put scientific theories into practice.
- Improving students' analytical and critical skills and encouraging them to be creative in natural science field. (Ottander & Grelsson, 2006).

Students should interact directly with certain equipments, objects and their environments so that permanence of learning can be achieved. If a permanent behavioral change is to be created for the student, it will be

useful to bring various materials, class equipments or various models regarding the subject to be learned in classroom or laboratory into learning-teaching environments. Students can learn not only in classrooms but in laboratories and social environments with direct teacher assistance or with their guidance. This kind of learning can be achieved individually or in a group work. Individual learning will improve students' self confidence. If no individual method is used and student is active, learning will be powerful and profound. Laboratory enables this possibility. But information is not given in the laboratories as quick as in lecture method. Laboratory studies enable students to be more active while using classroom materials during learning process, increase their desire and interest towards research, and leads them to creative thinking (Büyükkaragöz, 1997). Knox, Moynihan and Markowitz (2003)' research that focuses on the short term effect of natural science programs maintained with laboratory practices during summer period on high school students. They concluded that these kinds of programs help students understand scientific research and the nature of science, and enable them to see career opportunities. Maintaining long term laboratory attendance and using advanced level of techniques enables students to gain more experience and positive attitude that will improve their attendance to researches and experiments (Markowitz, 2004).

That students are interested in the subject being taught and satisfied with what they are doing influence their success in exams and tests. Attitude is of great importance among the factors that influence students' success in every education level (Oskay, Erdem, & Yılmaz, 2009). Life of the knowledge is short in human mind while attitude is a continuous phenomenon (Osborne, 2003). Attitude is influenced by many variables such as age, gender, home and school media, teacher's personality and instruction technique, previous knowledge and experience, and the attitudes and behaviors of parents. However, the studies performed state that attitude towards natural science is influenced most by laboratory studies (Oskay et al., 2009). Especially if the teacher gives place to laboratory activities which students can make by their own in the classroom and if these activities are based on experiments and researches, students gain positive attitude towards natural science (Ornstein, 2006). In a research that focuses on the effects of developed laboratory teaching methods on primary education students, it was observed that the attitudes of males are higher than those of females in terms of gender variable, and it was also revealed that there was more increase in the attitudes of the students with low performances than students with high performances when their performances are compared. (Adesoji & Raimi, 2004).

In this study, towards natural science laboratory activities, attitudes and laboratory perceptions of students who use and do not use laboratory in natural science and technology classrooms were explored. The objective of the study is to reveal whether there is a difference between attitudes and laboratory perceptions of students who use laboratory in natural science and technology classes, and who do not use laboratory, and to reveal in what way there is a difference if there is any. For this purpose, answers were tried to be given to the questions below:

1. Do the attitudes of students towards natural science laboratory practices differ from each other for the students who use laboratory in natural science and technology classrooms and for those who do not use laboratory?
2. Do the attitudes of students towards natural science practices differ according to gender?
3. Do the natural science perceptions of the students differ according to students who use laboratory in natural science and technology classrooms and those who do not use laboratory?

2. METHOD

2.1. Research Model

In this study, relational model based solely on post-test control group was used. Relational model is used in studies where cause and effect relationship cannot be established, and manipulation or control cannot be applied or partially applied due to practical reasons by its very nature (Erkuş, 2005). This study lasted for six months. Lectures were given in laboratories for experimental group students and in classrooms for control group students.

2.2. Study Group

This study was conducted in a primary school located in the centre of Antalya, in two classrooms comprising of 6th grade students who use laboratory and who do not use laboratory for natural science and technology lessons. Experimental group comprised 42, control group comprised 44 and in total, working group comprised 86 students. 44 students were male and 42 were female. The reason for this study to be conducted in 6th grade students is that these students were not given Natural Science and Technology lessons in laboratory mediums during their 4th and 5th years. Hence measuring student attitudes and laboratory perceptions towards targeted laboratory practices yielded more prolific results.

2.3. Instruments

In this study, two different data collection tools were used. The first one is “Natural Science Lesson Laboratory Practices Attitude Scale”, and the second one is students’ laboratory medium drawings. “Chemistry Attitude Survey” which was calculated by Yesilyurt (2003) to have 0,83 reliability and 0,90 alpha value and have 0,70 reliability in Turkey with Split-half method was adopted to Natural Science laboratory. The adopted scale was used in this study.

Drawing method was used in the study to examine students’ opinions towards natural science. In these methods, students were asked to draw the laboratory medium they imagine in Natural Science and Technology lesson practices and explain their drawings in a few words. It turns out that researchers feel responsible for the use of techniques that allow students to describe students’ perspectives with their strongest aspects and with their own choices. Drawing technique is a method that needs to be used cautiously and responsibly to enable active participation of students’ worlds just like they see in real life (Horstman, Aldiss, Richardson, & Gibson, 2008).

2.4. Data Analysis

The comparison of past year grade point average was observed to determine whether experiment and control groups are equal to each other.

Post-test group t-test was used to determine the attitudes of students towards Natural Science and Technology lesson laboratory practices and to determine whether they differ in terms of gender variable.

The assessment criteria for drawings were categorized in terms of giving place to materials appropriate to 6th grade Natural Science and Technology lesson learning fields and in terms of giving place to computer or other technological devices, and they were presented as follows:

- Living beings and Life
- Substance and Transformation
- Earth and Universe
- Laboratory Medium
- Computer and Other Technological Tools

Drawings were assessed individually by researchers. In assessment process, such a coding method as “present” or “absent” was used according to the existence of relevant material determined in student drawings. In cases when assessment results do not correspond, drawings were debated unless a consensus was obtained for each category. The relation between experiment and control was observed through calculation of K_i^2 while assessing students’ drawings.

3. FINDINGS

In this section, pre implementation processes regarding group equation, post-implementation laboratory attitude scale implemented on experiment and control group and data gained through drawings to determine laboratory perception were analyzed with statistical techniques. Findings obtained through analysis made were tabulated and comments based on analysis result were made.

3.1. Implementing group equation

Table 1: T-test Results Regarding Experiment and Control Group Equation

Group	N	X	SS	Sd	t	P
Experiment	47	79.04	15.39	93	.21	.83
Control	48	78.38	14.82			

Examination of Table 1 shows that academic success average of experiment group students is 79.04 and that academic success average of control group students is 78.38. It was also examined with t-test for independent groups whether there is a meaningful difference between academic successes of the groups, and it was observed that there is not a meaningful difference between groups according to t value calculated and significance level in 95 % confidence interval ($p>.05$). It can be said that both group are equal in terms of academic success points.

3.2. Distribution Results of Students' Attitudes Towards Natural Science and Technology Lesson Laboratory Practices According to Groups

Table 2: T-test Results regarding Experiment and Control Group Attitudes towards Natural Science and Technology Lesson Laboratory Practices

Group	N	X	SS	Sd	t	p
Experiment	47	120.80	16.32	93	2.58	.011
Control	48	113.35	11.40			

Examination of Table 2 shows that average points regarding students' attitudes towards Laboratory Practices is 120.80 for experiment group and 113.35 for control group. Standard deviation of the experiment group was found to be 16.32, and 11.40 for control group. According to t test value calculated between experiment and control groups, it was concluded that there is a meaningful difference among their attitudes towards laboratory. When we have a look at the average and standard deviation values, it can be said that this difference is in favour of experiment group. It was also observed that students who take laboratory lesson show more positive attitude towards laboratory than those who do not take laboratory lesson. This finding corresponds to the studies of Adesoji and Raimi (2004), Yeşilyurt et al. (2005) and Oskay et al. (2009).

3.3. Distribution Results of Students' Attitudes Towards Natural Science and Technology Lesson Laboratory Practices According to Gender

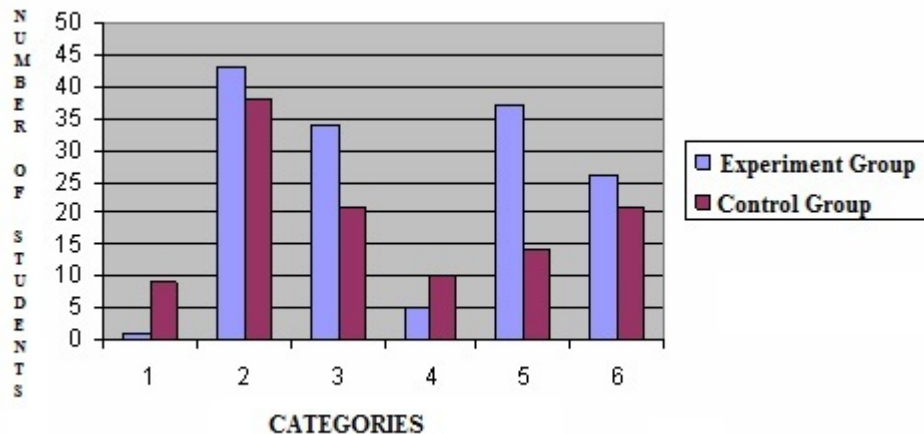
Table 3: T-test distribution results according to gender regarding Experiment and Control Group Attitudes towards Natural Science and Technology Lesson Laboratory Practices

Group	N	X	SS	Sd	t	p
Female	51	117.31	13.42	93	0.19	.84
Male	44	116.72	15.75			

Examination of Table 3 shows that there is no meaningful difference at a level of 05 between female and male student attitudes towards laboratory according to t test results regarding Students' Laboratory Practice Attitudes. ($p>.05$) It was concluded that arithmetic average of female students is 117.31 and that of male students is 116.72.

Examination of students' attitudes according to gender shows that there is no difference between the attitudes of female and of male students. When attitude towards laboratory is examined according to gender variable, this finding corresponds to the results which reveal that the study of Oskay (2009) points out that female students develop positive attitude and the study of Greenfield (1997) and of Osborne (2003) points out that male student develop positive attitude. This difference might have arisen because the study was conducted on different age groups and different cultures.

3.4. Assessment Results of Experiment and Control Group Drawings



Graphic 1: Laboratory Medium of Student Drawings, Use of Technology and Frequency Graphic of Perceptions Regarding Learning Areas. Categories. 1 Traditional laboratory medium, 2. Substance and Transformation 3. Physical Phenomena 4. Earth and Universe 5. Computer and Technology 6. Living beings and Life

It was observed that student drawings belonging to both groups comprise data regarding all assessment standards but experiment group students reflect these criteria densely on their drawings compared to control group students.

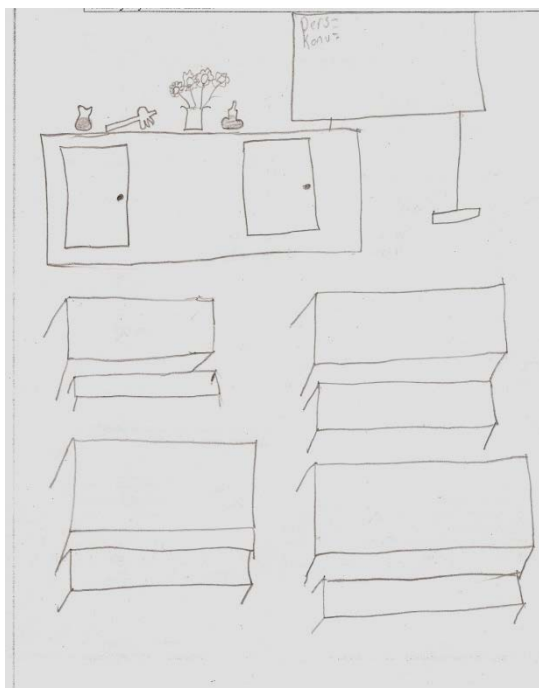


Figure 1: A Student Drawing
Belonging to Control Group

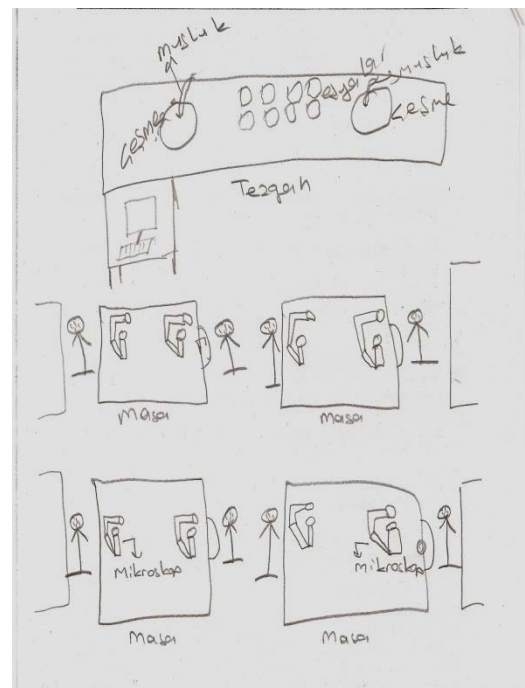


Figure 2: A Student Drawing
Belonging to Experiment Group

It was observed that in student drawings belonging to control group, laboratory medium is generally in traditional form while in student drawings belonging to experiment group, laboratory medium is in the form of ideal laboratory medium rather than traditional classroom formation. Sample drawings regarding this situation have been shown in Figure 1 and Figure 2.

3.5. Assessment of Experiment and Control Group Students' Drawings

Table 4: Assessment of the drawings of students who use laboratory and who do not use laboratory regarding the determined dimensions.

Living Beings and Life					Computer and Other Technological Tools						
GROUP	present	absent	TOTAL		GROUP	present	absent	TOTAL			
	N	21	26	47	$\chi^2 = 1.27$		N	10	37	47	$\chi^2 = 23.45$
EXPERIMENT	%	44.7	55.3	100		EXPERIMENT	%	21.3	78.7	100	
	N	27	21	48	Sd= 1		N	34	14	48	Sd=1
CONTROL	%	56.3	43.8	100		CONTROL	%	70.8	29.2	100	
	N	48	47	95	P= .307		N	44	51	95	P=.00
TOTAL	%	50.5	49.5	100		TOTAL	%	46.3	53.7	100	
Substance and Transformation					Laboratory Medium						
GROUP	present	absent	TOTAL		GROUP	present	absent	TOTAL			
	N	4	43	47	$\chi^2 = 3.70$		N	1	46	47	$\chi^2 = 6.96$
EXPERIMENT	%	8.5	91.5	100		EXPERIMENT	%	2.1	97.9	100	
	N	11	37	48	Sd=1		N	9	39	48	Sd=1
CONTROL	%	22.9	77.1	100		CONTROL	%	18.8	81.3	100	
	N	15	80	95	P=.089		N	10	85	95	P=.015
TOTAL	%	15.8	84.2	100		TOTAL	%	10.5	89.5	100	
Earth and Universe					Physical Phenomena						
GROUP	present	absent	TOTAL		GROUP	present	absent	TOTAL			
	N	42	5	47	$\chi^2 = 1.85$		N	13	34	47	$\chi^2 = 7.96$
EXPERIMENT	%	89.4	10.6	100		EXPERIMENT	%	27.7	72.3	100	
	N	38	10	48	Sd=1		N	27	21	48	Sd=1
CONTROL	%	79.2	20.8	100		CONTROL	%	56.3	43.8	100	
	N	80	15	95	P=.21		N	40	55	95	P=.007
TOTAL	%	84.2	15.8	100		TOTAL	%	42.1	57.9	100	

Examination of the table above shows that there is no meaningful difference between control and experiment groups ($p > .05$) in 0.05 significance level in learning areas of Living Beings and Life, Substance and Transformation, Earth and Universe, that there is a meaningful difference between control and experiment groups in the criterions of possessing Physical Phenomena, Laboratory Medium, Computer and Other Technological Tools ($p < .05$).

The reason for the difference of Living Beings and Life, Substance and Transformation, Earth and Universe criteria in students' drawings between two groups might be because students can associate these subjects with their daily lives and immediate surroundings and the activities in these learning areas can be easily put into practice in classroom. Another reason for the difference might be teaching method. Akçay, Aydođdu, Yıldırım, & Şensoy (2005) revealed that teaching of 6th grade "flowering plants subject" with computer assisted instruction improves academic success compared to traditional teaching. Chang, Quintan, & Krajcik (2010) asked 7th grade

students to prepare a computer animation about chemical molecules and it turned out that they understood the subject of “substance” better. Meaningful difference of Computer and Other Technologic Tools, Laboratory Medium and Physical Phenomena criteria in student drawings in favour of experiment group might be due to the fact that this group used natural science laboratory in their lessons and in natural science laboratories technological tools are used more actively. What is more, that physical phenomenon enable students to do experiment rather traditional method can be considered another reason. In their study, Hançer and Yalçın (2007), observed the influence of computer-aided learning method on attitude and concluded that computer-aided learning method based on constructivist approach in natural science education influences students’ attitudes positively towards computer compared to traditional learning method.

4. DISCUSSION

Examination of student attitudes shows that students using laboratories adopt more positive attitude towards laboratory than those who do not use laboratory. The results of the study show parallelism with the study of Oskay et al. (2009) where the effects of chemistry laboratory practices on student attitudes are observed. Tezcan (2006) found that students wanted a laboratory aided chemistry education and they find it useful for chemistry learning. But this result becomes different for the opinions of last grade high school students. Students perceive laboratory practices as waste of time since they are getting ready for university entrance exam. Yesilyurt et al. (2005) concluded that primary education students develop positive attitude towards natural science laboratory. The findings concerning biology laboratory practice assessment show that increased experience in students’ minds towards biology laboratories and experiments and theoretical lessons going parallel with each other improves the importance of laboratory practices (Yeşilyurt, 2006).

Examination of student attitudes according to gender reveals that there is no difference between the attitudes of female and of male students. Examining the interest towards natural science and the differences of gender and age, Greenfield (1997) concluded that male students have more positive attitude towards natural science than female students.

Oskay et al. (2009) revealed that female students have more positive attitude than male students when students’ attitudes towards chemistry lesson is examined according to gender. In his study, Osborne (2003) concluded that male students have more positive attitude than female students especially in Physics and Biology subjects. The reason for such a difference might be because it was conducted on different age groups and different cultures. What is more, another reason might be the lessons branching in secondary education and students choosing fields according to area of interest.

In their study concerning 6-12 year-old children, Hortsman et al. (2008) revealed that students can convey their perceptions and opinions more easily with drawing technique. In this study, students were asked to convey their opinions in a few words in written along with drawing technique. It was also revealed in the assessment of drawings that experiment group students have higher laboratory perception in Laboratory Medium, Computer and Other Technologic Tools, Physical Phenomena criteria. In Living Beings and Life, Substance and Transformation, Earth and Universe criteria, there was no difference in laboratory perceptions. Difference in perception is generally about Laboratory Medium and Use of Technology. When learning areas are examined, the difference is only in Physical Phenomena learning. The reason for this difference might have stemmed from the fact that unity and gain number is more than the others. What is more, teacher attitude might also have influenced the difference. The study of Tsai (2003) reveals that Taiwanese students can cooperate with adequate materials and applicable rules and they prefer a laboratory medium where they can make open ended researches and learn deeply the connections between theories. The study of Yesilyurt (2006) support the studies conducted, and reveal that plenty of image and graphic utilization about subject in laboratories, giving as much place as possible to individual studies and use of new technologies create a suitable environment so that biology laboratory studies can be more effective and have required output. In their study, Klahr and Li (2005) argues that teaching via integration of regular laboratory medium and complicated classroom can fill the learning gaps that might arise in students’ mind and can enable meaningful learning. In their study, Tweedy and Hoese (2005) concluded that teachers emphasize the necessity of attainable materials and the practices which will encourage research in laboratory mediums.

5. SUGGESTIONS

Suggestions achieved according to findings and results are as follows:

- Experimental activities should be given which will improve scientific thought and problem solving skills so that students can develop positive attitude in Natural and Technological classes.
- Students should be encouraged by teachers to use natural science laboratories.
- Teachers should explain students the importance of experiments and laboratory culture.
- Natural Science and Technology periods should be increased considering laboratory practices in Natural Science and Technology classes.
- New classrooms which will include laboratories belonging to Natural Science and Technology classes.
- Natural Science and Technology Teachers should be subject to on-the-job training about laboratory practices.
- Natural Science and Technology Teachers should be encouraged to use laboratory.
- Necessary arrangement should be made about material supply in natural science laboratory so that teachers will not experience difficulty.
- In schools where there is no natural science laboratory, teachers should be provided with on-the-job training on how to conduct practice experiments in classrooms.

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