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# Determination of Primary School Teachers Candidates' Thoughts on Laboratory Report Writing

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This study was carried out to determine the opinions of the pre-service primary teachers about the laboratory report writing in laboratory courses. Data were collected by using an open-ended questionnaire. The sampling of the study consists of 68 pre-service primary teachers who situated at a public university in the northeast of Turkey. Data were analyzed using content analysis. Two faculty members and one teacher jointly assessed the responses of the pre-service primary teachers to the questionnaire and determined the themes and codes for each question. The results showed that the pre-service primary teachers in the study paid attention to the content while writing laboratory report in the laboratory course. Also, they had positive and negative opinions about the contribution of laboratory report on their learning. Some of the pre-service primary teachers stated that writing a laboratory report had positive effects such as providing learning, encouraging thinking, reinforcing what was learned, increasing interest and attention towards the lesson, and ensuring the permanence of the concepts learned. Some of the pre-service primary teachers thought that writing reports had a negative effect such as being boring and not contributing to the development of the individual. In addition, it was determined that performing a laboratory report reduced the students' interest in the course and pre-service primary teachers did not want to write a laboratory report. However, pre-service primary teachers accept that laboratory report increases their ability to comment.

## Introduction

In a world full of the products of scientific research, scientific literacy has become a necessity for all members of society. People need to use scientific knowledge to make choices to meet the standards that arise at all stages of the daily life (National Research Council, 1996). Scientific literacy is defined as a combination of science-related skills, attitudes, values, understanding and knowledge necessary for individuals to develop research-questioning, critical thinking, problem-solving and decision-making skills, to become lifelong learning individuals, and to maintain curiosity about their environment and the world (Ministry of National Education, 2006). Scientific literacy, such an important concept, can only be taught to students in science courses (Bozdoğan & Uzoğlu, 2015). It is a known fact that the science courses are mostly based on experiments and activities and that the concepts in the science course are theoretical and abstract (Tekbıyık & Akdeniz, 2010). Science course can be considered as a very difficult and comprehensive course with its subject matter and

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laboratory applications. This course includes some disciplines such as physics, chemistry, and biology as well as mathematics. The realization of all laboratory activities is a very difficult and problematic process. It is necessary to activate individuals in the teaching environments in order for raising them who are investigating, questioning and constructing knowledge. This is relatively easy to achieve when teaching science because there are laboratory activities and experiments that can lead the students to research, question and examine (Ulu & Bayram, 2014).

Laboratories are seen as an essential part of science (Alkan, Çilenti & Özçelik, 1991). Chiappetta and Collette (1989) see the laboratory as places where the theoretical knowledge learned in the classroom can be shown, clarified and facilitated the learning. For this reason, laboratories can be considered as the ideal environment for students to develop their ability to ask scientific questions (Polacek & Keeling, 2005). The laboratory plays an important role in understanding scientific communication rules, in acquiring cognitive skills such as scientific thinking and questioning skills (Hofstein, Shore & Kipnis, 2004), in the development of psychomotor skills and in the taste of discovery (Bayraktar, Erten, & Aydoğdu, 2006). In addition, laboratories can be seen as learning areas in which students run their cognitive, affective and psychomotor skills as a whole and develop their high-level thinking skills (Tatar, Korkmaz, & Ören, 2007). Although it has been stated by many researchers that laboratories contribute to the development of students (Meriç, 2003; Tamir, 1997), traditional laboratory activities are also frequently criticized. Traditional laboratory activities take place in the form of a set of instructions given to students by teachers, or a validation of known scientific concepts or principles (Schroeder and Greenbowe, 2008). A well-planned laboratory practice allows students to learning experience that reflect scientific inquiry-nature of scientific inquiry. However, most of the time, validation experiments are carried out in science laboratory practices, which are far from scientific inquiry- nature of scientific inquiry. It is clear that students will not be able to gain the competencies and understandings which are necessary for scientific literacy through the traditional laboratory practices that reflect these practices, which are similar to a cookbook so that they follow the instructions given to them. For this reason, in the traditional laboratory environment, the teacher guides the students about the data collection, processing and interpreting by the laboratory papers or laboratory books. These laboratory activities in which one-dimensional learning can take place can cause students to learn meaningless and purposeless by taking the information individually or in pieces (Tatar, Korkmaz & Ören, 2007).

Experiments which are very important in science teaching can be carried out in various ways in the laboratory. However, the effective use of the experiments depends on the procedures to be carried out during the planning, conducting, and finalizing the experiments. In addition to these stages, laboratory report writing constitutes an important step of laboratory practices (Özmen & Yiğit, 2005). The most commonly used writing activity in undergraduate level laboratory applications is the activity of generating a laboratory report writing. The laboratory reports are usually written in the form of a traditional report (Aslan & Tekin, 2015). The laboratory reports are the most frequently used writing types in primary school, middle school, high school, and higher education institutions as well as at the undergraduate level. In the laboratory report, the students write the experimental tools, the aim of the experiment, the conduct of the experiment and the conclusion and interpretation part of the experiment. According to Hand & Coi (2010), traditional laboratory reports consist of objective, method, data, findings and conclusion sections.

The using of writing activities, including laboratory report writing, in the learning-teaching

process, has recently become widespread and has been the subject of research in many studies (Demirbağ, 2011; Uzoğlu, 2010; Yıldız, 2016; Yıldız & Büyükkasap, 2011a,b,c). The writing for learning is based on the work of Emig (1977). Emig assumes that writing is a unique way of learning. It is stated that writing is a tool that enables individuals to express their ideas more easily (Langer & Applebee, 1987) and has an important role in the change or development of ideas (Gere, 1985). It also allows students to actively structure information as it involves processes such as writing, decision-making, questioning, imagining, exploring and organizing information. On the other hand, writing is also important in transforming basic ideas and in making information consistent and organized (Rivard & Straw, 2000). Writing is not only a tool used in the structuring of knowledge but also a communication and inquiry tool that enables the transmission of thoughts to different readers (Prain & Hand, 1999). Writing for learning (Hand & Prain, 2002), rather than an assessment tool, can be considered as a powerful tool that helps students to learn science (Levin & Wagner, 2006).

The writing activities used in the teaching-learning process mostly include writing abstracts, taking notes on the board, writing posters and laboratory reports. In addition, different types of writing can be shown as stories, letters, brochures, diaries, diagrams, poems, instructions, explanations or concept maps (Uzoğlu, 2010). Laboratory reports used in the laboratory environment are the most commonly used writing type in primary, secondary, high school, and higher education institutions. In the laboratory report, the students write the experimental tools, the aim of the experiment, the conduct of the experiment and the conclusion and interpretation part of the experiment.

When the literature is examined, it is noteworthy that the number of studies on writing a laboratory report is small and that it is mostly related to experimental applications. Nakhleh (1994) examined the effectiveness of laboratories as a learning environment and evaluated the effectiveness of laboratory practices in the context of constructivist learning theory. Nakhleh (1994) stated that the students could not construct their knowledge during the laboratory practices and could not create meaningful learning. Keys, Hand, Prain & Colins (1999) found that most of the eighth-grade students perceive writing reports as completing sentences. Günel (2009) states that the use of non-traditional writing activities in laboratories, unlike traditional laboratory reports, is an approach that allows the production of cognitive and metacognitive activities. On the other hand, Aslan & Tekin (2015) found that reporting of laboratory practices differently did not make a difference between the learning levels of control and experimental group students in their study. Meriç (2003) argued that the use of the V diagram would be more effective than writing a traditional report. Nakiboğlu & Meriç (2000) at the beginning of their research about the use and application of V-diagrams in General Chemistry Laboratories examined the students' thoughts about writing a laboratory report with laboratory applications. Orbay, Özdoğan, Öner, Kara & Gümüş (2003) also investigated the students' thoughts about writing a laboratory report in their studies on the difficulties encountered in the Science Laboratory Applications I-II course and their solution suggestions. Ayas, Karamustafaoğlu, Sevim & Karamustafaoğlu (2002) also asked the students the contribution of the laboratory reports to the comprehension of experiments in their studies about the evaluation of the general chemistry laboratory applications from the perspective of students and instructors. Doğan et al. (2003) also investigated the attitudes of biology students towards their laboratory studies and asked questions about their laboratory reports or notes they had taken. Koray, Köksal, Özdemir & Presley (2007) found that the science process skills of pre-service teachers studying with creative and critical thinking based on laboratory practices had higher scores than the control group studying with traditional laboratory practices. İnce, Güven & Aydoğdu (2010), in their study, tried to determine whether the teaching method

based on concept map and V diagram had an effect on students' academic achievement and permanence of the knowledge they learned in science laboratory applications course. Uzoğlu (2014), in his study conducted with pre-service science teachers, found that the diary and letter writing group was statistically more successful than the laboratory report-writing group. Çepni et al. (1997) emphasized the importance of writing a laboratory report after the experiments.

Science laboratories, which involve courses such as physics, chemistry, and biology, play an important role in the understanding of these relatively abstract courses. Especially the curricula of science education and primary school education departments within faculties of education contain science laboratory courses. Activities and practices aimed at supporting the theoretical knowledge offered to pre-service primary teachers (PPTs) are carried out in laboratories. They are requested to write laboratory reports about the activities, tests, and practices they carry out in these environments. However, taking students' views about writing a laboratory report, which is very common in the educational process, has been neglected. On the other hand, it is known that the steps were taken by receiving students' or teachers' views can make the learning process more efficient. The literature contains almost no study dealing with writing a laboratory report. The few studies in the literature have focused on determining students' views about laboratory practices. As can be seen from the literature review, laboratory report writing is widely used. However, it is a great deficiency that the PPTs, who are the first teachers to compare students with science courses, have not received their opinions on writing a laboratory report. Because it is known that the studies to be conducted by taking into consideration the opinions of PPTs can make the learning process more efficient. Therefore, the aim of this study is to determine the views of pre-service science teachers about the laboratory report they encounter. In this sense, the following question and sub-questions are guided to this study.

What do PPTs think about writing a laboratory report?

(1) What do PPTs pay attention when writing a laboratory report?
(2) What do PPTs think about the contribution of writing a laboratory report to their learning?
(3) What do PPTs think about the effect of writing a laboratory report on their ability to comment?
(4) How do PPTs think that writing a laboratory report affects their interest in the lesson?
(5) What do PPTs think about continuing to write a laboratory report if it is optional?
(6) What do PPTs think about when to write the laboratory report?
(7) What do the PPTs think about the use of other friends when writing a laboratory report?
(8) What resources do prospective teachers use when writing a laboratory report?

## Methodology

The special case method was used in this study. This method allows the study of one aspect of the problem being investigated in-depth and in a short time. The most important advantage of this method is that it gives the opportunity to concentrate on a particular situation of a problem (Çepni, 2007). This method focuses on the characteristics of a situation and allows the use of different data collection techniques (Cohen & Manion, 1994). An open-ended survey, which consists of eight open-ended questions, was used to determine

participants' views of laboratory writing reports. All data were analyzed through content and descriptive analysis.

### *Sample and Data Collection*

The sampling of the study consists of 68 pre-service primary teachers (PPTs) who situated at a public university in the northeast of Turkey. The PPTs who participated in the study were selected from 2 courses in terms of accessibility by simple random selection. Table 1 below shows the distribution of these teachers by gender. The reason for the selection of PPTs, who are in their 3rd year, is that they have currently taken laboratory courses and have written laboratory reports in the science laboratory course. The instructor shared his laboratory instructions with his students (PPTs) one week before the course had started. After PPTs applied the experiments according to the instruction, they reported the data and comments obtained during the application and transmitted to the instructor.

Table 1. Distribution of the study group by gender.

| **Gender** | |
|---|---|
| Male | Female |
| 28 | 40 |

#### *Data source*

In this study, open-ended questions were used as a data collection tool. The open-ended questions were designed to identify PPTs' opinions about writing a laboratory report. The draft questionnaire consisting of 9 questions was formed by examining the related literature, and the number of questions was reduced to 8 according to the views of 2 faculty members and 1 science and technology teacher. The final version of the questionnaire consists of 8 open-ended questions. Then, a preliminary study was conducted by applying the questionnaire to 8 pre-service primary teachers, the points that PPTs had difficulty understanding were revised and necessary corrections were made in the questionnaire. The average time for completing the survey was 20 minutes.

#### *Analysing of Data*

Qualitative data obtained from open-ended questions were subjected to content and descriptive analysis. Two faculty members and one teacher jointly evaluated the PPTs' responses to the questionnaire. Then The responses were coded according to the questions in the open-ended survey and the themes and categories were created by 3 researchers. In this context, the first researcher created 22, the second researcher created 19, and the third researcher created 25 themes. The researchers concluded that the entire data set could be created in 22 different themes. The points of disagreements in the analysis process were discussed and a consensus was reached. The frequency and percentage of each expression are given, depending on the themes and codes uncovered. Below the table, expressions of PPTs are indicated with percentages. The PPTs' opinions related to each question were based on the answers given by the relevant codes and the percentages were shown according to the sum of these frequencies. Necessary explanations and comments about PPTs' thoughts were provided below the tables.

## Findings / Results

Findings for each question are presented in below tables. The necessary comments are given below each table.

R.Q. 1. (Related to research question 1), it was aimed to understand what PPTs pay attention to when writing a laboratory report. The frequency and percentages of the answers given to the question are shown in Table 2.

Table 2: Considerations When Writing a laboratory Report

| Theme | Code | Frequency | Percentage (%) |
|---|---|---|---|
| Content of the laboratory report | Aim | 32 | 22 |
| | Writing accurately and precisely | 21 | 15 |
| | The order of materials used and the accuracy of theoretical information | 18 | 12 |
| | Scientific knowledge | 20 | 13 |
| The shape of the laboratory report | Page layout | 22 | 15 |
| Stages of the laboratory report | Stages of the experiment and writing the experiment | 20 | 13 |
| Others | The points emphasized by the teacher in the experiment | 10 | 7 |
| | Be the same as my group friends | 5 | 3 |
| Total | | 148 | 100 |

It is seen that PPTs are focused on 4 themes: the content of the laboratory report (61%), the form of the laboratory report (15%), the stages of the laboratory report (13%) and the other (10). It is noteworthy that PPTs mostly pay attention to the content when writing a laboratory report. Regarding the content of the report, PPTs stated that they pay attention to the aim (22%), to write correctly and completely (14%), to the order of materials used, to the accuracy of theoretical information (12%) and the scientific (13%) information. On the other hand, it is seen that the rate of those who stated that they pay attention to page layout (15%) is high. *Some of the PPTs' opinions about paying attention to when writing a laboratory report are as follows.*

> *Ö1: "When writing an experiment report, I make sure that what I write is accurate and scientific."*
> *Ö7: "Page layout is important for me "*
> *Ö12: "The teacher's emphasizing about the experiment helps me to write the report."*

R.Q.2. (Related to research question 2), it was aimed to understand what PPTs think about the contribution of writing a laboratory report on their learning. The frequencies and percentages of the answers given to the question are shown in Table 3.

Table 3: The contribution of writing a laboratory report to learning the subject

| Theme | Code | Frequency | Percentage (%) |
|---|---|---|---|
| Positive | Keeping learned knowledge in mind, reinforcing | 68 | 53 |
| | Improvement of the ability to comment | 10 | 8 |
| Negative | Waste of time and nonsense | 20 | 15 |
| | Boring and tiring | 30 | 24 |
| **Total** | | 128 | 100 |

It was seen that PPTs' opinions about the contribution of writing a laboratory report to learning are gathered under two themes as positive (61%) and negative (39%). Those who think positively about the contribution of writing a laboratory report to learning, stated that it improves the ability to keep the learned knowledge in mind, reinforce (53%) and comment (8%); those who think negatively saw this process as a waste of time and a ridiculous (15%), tedious and tiring job (24%). *Some of the PPTs' thoughts about learning the subject while writing a laboratory report are as follows.*

*Ö28: "I think that I have reinforced my understandings better by writing an experiment report."*

*Ö45: "I think writing an experiment report is a good thing for learning because I have more information in my mind."*

*Ö32: "Writing an experiment report means wasting my time. I wouldn't prefer to write if it wasn't necessary."*

R.Q.3. (Related to research question 3), it was aimed to understand what PPTs think about the effect of writing a laboratory report on their ability to comment. The frequency and percentages of the answers given to the question are shown in Table 4.

Table 4: The effect of writing a laboratory report on the ability to comment

| **Theme** | **Code** | **Frequency** | **Percentage (%)** |
|---|---|---|---|
| Effective | Thinking, making ideas | 76 | 94 |
| Ineffective | No effect | 5 | 6 |
| Total | | 81 | 100 |

They thought that it was effective (94%) and ineffective (6%) about the effect of PPTs' writing a laboratory report on their ability to comment. Those who think that it is effective to have stated that writing reports encourage them to think and produce ideas. *Some PPTs' opinions about the effect of writing a laboratory report on their ability to comment are as follows.*

*Ö 1: "I have to say that the effect of not commenting is excessive. But I get bored when I write."*

*Ö 8: "Writing a report certainly improved my comment skills."*

*Ö 25: "Since I don't like writing laboratory reports, I can't say that it has an effect on my ability to comment."*

R.Q.4. (Related to research question 4), it was aimed to understand what PPTs think about writing a laboratory report affects theirs' interest in the lesson. The frequency and percentages of the answers given to the question are shown in Table 5.

Table 5: The effect of writing a laboratory report on the interest in the course

| **Theme** | **Code** | **frequency** | **Percentage (%)** |
|---|---|---|---|
| Decreasing interest | It's boring, which reduces my interest in the class. | 14 | 19 |
| Increasing Interest | Increases my attention and interest | 38 | 53 |
| | We write because we have to write | 3 | 4 |
| Nötr | Does not affect in any way (does not contribute) | 17 | 24 |
| Total | | 72 | 100 |

It is seen that the PPTs' opinions about the effect of writing a laboratory report on their interest in the lesson are gathered under three themes: 19%, increasing interest (53% and no effect (28%). They thought that it was a decrease in interest (19%) and increased interest in the lesson (53%). *Some of the PPTs' opinions about the effect of writing a laboratory report on the interest towards the course are as follows.*

*Ö 38: "I certainly don't want to write, but it's a mandatory. It made me out of class."*

*T 65: "It contributed to my learning, so I started to like the lesson more."*

R.Q.5. (Related to research question 5), it was aimed to understand what PPTs think about continuing to write a laboratory report if it is optional. The frequency and percentages of the answers given to the question are shown in Table 6.

Table 6: On-Demand Laboratory Report Writing Status

| Theme | Code | frequency | Percentage (%) |
|---|---|---|---|
| I write | reinforcing information, increasing permanence | 46 | 52 |
| | not wanting another activity | 11 | 12 |
| | I have no idea about another event | 7 | 8 |
| | discussion after experiment | 4 | 5 |
| I don't write | questioning effectiveness, the test can be done | 13 | 15 |
| | notes taken during the experiment are sufficient | 4 | 5 |
| Other | | 4 | 5 |
| Total | | 89 | 100 |

If it is optional, the status of writing a laboratory report changes to write (52%), unwilling to write (43%) and other (5%). *Some of the PPTs' opinions about the status of writing a laboratory report are as follows.*

*Ö 52: "I want to write because I learn the subject better."*

*Ö 44: "I don't want to write. It would be fun to have a discussion instead."*

R.Q.6. (Related to research question 6), it was aimed to understand what PPTs think about when to write the laboratory report. The frequency and percentages of the answers given to the question are shown in Table 7.

Table 7: When to write the laboratory report

| Theme | Code | Frequency | Percentage (%) |
|---|---|---|---|
| After course | follow the lesson, take notes | 32 | 37 |
| | Reinforcement | 19 | 22 |
| During the course | not to forget | 33 | 38 |
| Other | | 3 | 3 |
| Total | | 90 | 100 |

It was stated that PPTs wanted to write a laboratory report after the lesson (59%) and during the lesson (38%). Those who want to write after class stated that they prefer to follow the course and take notes. For those who want to write during the course, they prefer this way not to forget the information. On the other hand, 3% of the PPTs did not express any opinion. *Some of the PPTs' opinions about the time of writing a laboratory report are as follows.*

*Ö 7: " We should report at home what we have applied in the lesson rather than writing in the class. But it is only about theoretical knowledge and outcome."*
*Ö 60: "It is easy for me to write during class, I want to write without forgetting."*

R.Q.7. (Related to research question 7), it was aimed to understand what PPTs think about the use of other friends when writing a laboratory report. The frequency and percentages of the answers given to the question are shown in Table 8.

Table 8: Benefit from others when writing a laboratory report

| Theme | Code | frequency | Percentage (%) |
|---|---|---|---|
| I don't benefit | No, my views and expressions are sufficient | 68 | 76 |
| I benefit | Of course, I do, they may have seen what we didn't see | 17 | 19 |
| | I will benefit if I'm too hard | 3 | 4 |
| Other | | 1 | 1 |
| Total | | 89 | 100 |

When the answers of the PPTs were examined, 76% of the PPTs stated that their opinions and expressions were sufficient when writing a laboratory report and therefore they were not affected by the writing of reports by other groups. In a small group of 4%, they stated that they would benefit from the reports of others if they were forced to write a laboratory report. *Some of the PPTs' opinions about the use of others when writing a laboratory report are as follows.*

*Ö 9: "I write myself because my knowledge is sufficient. "*
*Ö 16: " When I can't do it myself, I try to write it after discussing it with others."*

R.Q.8. (Related to research question 8), it was aimed to understand what resources PPTs use when writing a laboratory report. The frequency and percentages of the answers given to the question are shown in Table 9.

Table 9: Resources used when writing a laboratory report

| Theme | Code | frequency | Percentage (%) |
|---|---|---|---|
| Comment | Writing your own statements. | 76 | 45 |
| Quotation | I write exactly from the available sources | 47 | 28 |
| | I write online | 36 | 21 |
| | I write what the teacher says in class | 10 | 6 |
| Total | | 169 | 100 |

When the answers of the PPTs were examined, 45% of the PPTs stated that they wrote their own statements, 28% of PPTs stated that they wrote exactly from the available sources, and 21% of PPTs stated that they wrote on the internet. On the other hand, 6% of PPTs stated that the teacher wrote what they said in the lesson. *Some of the PPTs' opinions about the sources used when writing a laboratory report are as follows.*

*Ö 52: "We write by looking at books or website."*
*Ö 5: "Usually it is appropriate for me to write my own sentences. Some of my friends look at someone else, but I try to write to myself."*

*Ö 9: "I copy and paste from ready sources. Because it's easier for me."*

**Discussion and Conclusion**

In this research, which is a descriptive study based on qualitative research methods, the opinions of pre-service primary teachers about writing a laboratory report in science laboratories were tried to be determined. As a result of the study, the pre-service primary teachers stated that they wrote the laboratory reports according to the purpose of the experiment without going out of the subject and considering the steps they made in the experiment. Few of the PPTs stated that they took into account the points emphasized by the instructor in the laboratory report.

The majority of the PPTs stated that writing a report makes the information learned to be kept in mind and reinforces. The rate of those who said that it increased the ability to comment was quite low. This result partially contradicts the studies of Uzoglu (2010) and Gunel (2009) that writing non-traditional laboratory reports in the laboratory might increase student achievement. As can be seen, the traditional laboratory report also increases student achievement. In addition, this result is similar to the work of Ayas, Karamustafaoğlu, Sevim and Karamustafaoğlu (2002) who stated that preparing a laboratory report is effective in learning the subject. In addition, the majority of PPTs stated that writing reports encourage them to think and produce ideas. As Tynjala (1998) emphasizes, writing activity may have improved students' thinking skills, provided reinforcement of learned subjects, and did not facilitate the recall of subject concepts.

In the research, it was determined that PPTs used different sources while writing the laboratory report. It was found out that some of the PPTs wrote their own ideas while writing a laboratory report and some of them wrote their reports by using the internet. According to another result of the study, writing a laboratory report increases attention and interest towards the course. However, only a few of PPTs were identified in the study in which they stated that laboratory writing was boring and had no effect on learning.

In addition, it was noteworthy that in the study, some PPTs did not want to write a laboratory report although they thought that laboratory writing increased learning. As a result of the study, the majority of the PPTs stated that they wanted to write a laboratory report after the experiment was carried out. This result is consistent with the results obtained by Çepni at al. (1997). The majority of the PPTs stated that their opinions and expressions were sufficient when writing a laboratory report and therefore they were not affected by the writing of other groups. A few of them stated that they would benefit from the reports of others if they were in a very difficult situation while writing a laboratory report. Depending on the results of this research and other studies in the literature, writing a laboratory report in the laboratory supports the development of students in many respects (Bayraktar, Erten & Aydoğdu, 2006; Chiappetta & Collette, 1989; Polacek & Keeling, 2005; Tatar, Korkmaz & Ören, 2007).

As it is reached from this study, it has been found that writing laboratory reports writing in laboratory courses have many benefits. It can be thought that ensuring that continuing to write a laboratory report will be important for achieving these benefits. However, since it is considered boring by many PPTs to write laboratory reports and they think that they do not make any contribution on them, the preference of non-traditional laboratory reports as mentioned in the literature may contribute to the PPTs. In particular, it may be suggested that PPTs can express their own opinions when writing a laboratory report from a source or a student without copying the report, as this may improve their interpretation.

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