Some Reflections From Pre-Service Elementary Teachers' Practice Teaching on the Area of Understanding Data in the Math-Teaching Course[1]

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Abstract

With developing technology statistical information and data sources become a very important issues and from primary school it has become necessary to gain the skills for making interpreting and making sense of data. These skills consist of collecting information, arrangement and analysis of collected data and the interpretation of the results. The duty of guiding students in their process of making statistical information meaningful falls upon teachers. This study, whose aim was to investigate prepared course content for sub-learning area in grade 1-4 math course and obtained experiences by pre-service elementary teachers in the schools they went as a part of teaching practice course, was conducted with nine fourth-year students attending an undergraduate program of elementary teaching in a state university during 2013-2014 academic year. Pre-service teachers were each asked to prepare and conduct a lesson plan suitable for the lesson outcomes and the level of the classes that they were to teach. Their applications were assessed by semi-structured observation form about data teaching developed by the researchers. It was observed that pre-service teachers could not reflect given lesson outcomes on the topic of data to the lessons they prepared to teach during their teaching practice. In the implementations, it was noted that pre-service teachers could not effectively include students in both collecting and arrangement as well as interpretation processes of the information and that they taught in teacher-centered manner although they prepared a correct activity. It was also noted that pre-service teachers could not well enough differentiate category and concept of variable in table and graph activities.

Keywords: Data instruction, pre-service teacher, teaching practice

Introduction

Math is not only a field about numbers and calculations but also a system that finds a place in many circumstances encountered in daily life. Developing technology offers a very rich visual world mankind. Maybe, primary school students are the group that spends the most effort trying to explain that visual world. It is because seeing and explaining many elements like figures, numbers, data, words etc. together is a process that have just been learnt. Primary school students will come across graphs and data not only in math lessons but also in science and social sciences and try to set some relationships. Therefore, the topic of data and its teaching is very important from an elementary teachers' point of view. Topıc of a graph in primary school provides an introduction to statistics, another branch of mathematics. Statistics, to answer a question, includes important skills like collecting data, summarizing data, making sense of data, interpreting, concluding for the future and deciding. Acquisition of the skills of data collection, data summation, making sense of data and inference are established as goals in primary schools (Olkun & Toluk Ucar, 2004).

Primary school students should be active in the problem-solving processes (forming questions and their answers, collecting data and its presentation, data analysis, and data inferences) about data. Teachers should encourage students to collect data and interpret them. Studying questions like "Let's assume that," and "What if…happens," provides students to better define the data analysis period and its nature (Franklin & Mewborn 2008). Real world is full of data and its sources. Children need to ask and answer real world questions like 'what?', 'how?', 'when?', 'where?', 'who?', 'why?' to collect data, to organize the data they collected, and to interpret. Therefore, it could be said that data analysis has more significance than in just forming and reading data. Children need to make judgments to collect data. When, at the first stage, facing prompting questions asked by their teachers, children feel a need to collect data. When a teacher says, "I think, plain ice cream would be the most loved ice cream in this class," the children will want to find out what kind of ice cream is the most loved one (Cathart, Pothier, Vance & Bezuk, 2006). Primary school students need to have developed some set of skills to find out the answers of the questions that they are curious about. Acquisition of these sets of basic skills since preschool constitutes an important section of the primary and secondary school mathematics education programs.

Children should come across, since preschool, activities that are aimed to develop the skills of ranking, sequencing, and analyzing. They label the properties of the objects by using characterizations like red, hot and circles. This kind of activities increases the skills of classification and comparison of groups with similarities and differences (Van de Walle, 2010). The first experiences of the students in the topic of data are their encounter with the objects whose properties are easily noticed. These kinds of objects and qualification cards are easy to produce or to obtain by the teachers, too. Some students start by classifying only one property, some can classify according to different properties, too. Teachers should help their students think in different ways when the students classify objects. Venn diagrams are one of the ways that facilitates students' job in classifying multiple properties of the objects. Overlapping circles simplify classifying multiple properties of the objects. Objects that fall outside of the categories will stay outside of the circles (Bahr & Garcia, 2010).

Primary school mathematics education program sees forming problems that could be answered by table or by summarizing in the form of graphs as fundamental purpose of teaching the topic of data. Giving precedence to activities of data, data analysis, simple classification for understanding statistics, comparison, and counting, the mathematics teaching program emphasizes that students form questions, which are meaningful in and

of themselves and determine the answers given to those questions, that the students should be directed to organize given answers; and then, that students can present data they collected in both tables and graphs. Examining the data teaching period in the mathematics teaching program, it is seen that reading tables and basic skills about the topic of data are included for first grade; object graphs and table formation in the second grade; figure charts, in which each picture represents one object only or a picture multiple objects in the third grade; formation of bar graphs, organization of data in a table or a graph and data analysis in the fourth grade. The program states that it needs to proceed from pictures to symbols or to more tangible presentations over time [Mathematics (1-5 Grades) Curricula, 2009]. It is attention drawing that the program emphasizes the skills advancing from the abstract to the concrete. The approach of the mathematics teaching program on the topic of data can be seen as an approach that featuring the development of the children's thinking about statistics.

Children's thinking in the topic of statistics can be investigated on four levels. The first level of those is to define data, the second to organize data, the third to present data, and the fourth to analyze and interpret data (Jones, Thornton, Langrall, Mooney, Perry & Putt, 2000). Stating that statistical thinking develops in four periods, Biggs and Collis (1991) define these periods as subjective, transitional, quantitative and analytical. While focusing on their own personal data and trying to make relationships with given data, first-level thinkers are not yet ready to draw conclusions, second-level thinkers start to notice importance of quantitative thinking and are not completely successful, even if they are able to use numbers when performing measurements and trying to make sense of data. The third-level thinkers start to use quantitative thinking, foundation of statistical reasoning, start to acquire the concepts about measures of central tendency, and start to, occasionally though, make relationships between the data and context in which the data are found. The fourth-level thinkers can find the data in their context and make relationships between the data and their context.

When investigating the presentations children use in their demonstrations, five common forms, parallel to development of statistical thinking, can be said to be found. These can be named as dynamic, pictorial, iconic, written and symbolic presentations. While dynamic representations are those with children's movements or acting which children perform live with the object itself, pictorial representations are those formed with the images of real things. Iconic presentations can be considered on the basis of using a sign for every counted unit. Iconic presentations can be considered as tables, but usages of tables are not the only way. It could be said that written presentations like words and sentences that we encounter everywhere all times are also among iconic representations. Children mostly prefer presenting data in written form, for instance, like two grapes as two pieces, four grapes as four pieces. Usages of standard presentations of numbers and signs are now the best examples for iconic presentations (Carruthers & Worthington, 2006).

Acquisition of basic skills on the topic of data will be the foundation to table and graph studies that they encounter in primary schools. Tables are the first tools to be used for organizing data for graphical studies. Tables like frequency tables can be used for organizing data before graph formation activities. It should be primarily decided that what table is needed before graph presentation (Friel, Curcio & Bright, 2001).

Tables are very handy techniques for recording the data. Children should be offered opportunities so that they discover ways of organizing data with table activities (Cathart, Pothier, Vance & Bezuk, 2006).

Children's graph experiences generally advance in four stages. The first period that starts with object graphs is the concrete stage; the one that which object and figure chartss are used together is concrete figure stage; following figure chart studies, the one in which symbolic figures are used instead of real picture of the object is figure-abstract stage; the last one, in which figures in tables and graphs are matched with multiple situations or objects rather than single situation or object is abstract stage (Cathart, Pothier, Vance & Bezuk, 2006). Graphs that are formed with real objects are the first stage of graph studies. Object graph activities should first be performed by using two objects and later more than two objects or situations. After performing these activities, graph studies can be done on the structures formed from lines and columns with the similar structures that can be used instead of real objects (Charlesworth, 2000). Children use some basic skills like counting, comparing, pairing, and classifying. For that reason to give graph activities a place, since preschool, is very important (Aktaş, 2006).

The number of categories to be compared is, too, as important as the number of object used to form a graph in object graph activities. For example, if the teacher makes his students face a graph about kinds of ice-cream that they like the most, he should primarily pay attention to choose graphs with two categories. This point, too, needs attention for figure chart activities following the activities conducted with object graphs and with two or three categories. Kinds of graphs to be used and number of categories are hierarchical elements that teachers should pay attention about in children's studies of reading and organizing graphs (Baratta-Lorton 1995; cited in Bahr & Garcia, 2010). This hierarchy is shown in terms of kinds and numbers of groups.

Table 1. *Kinds of graphs and number of groups compared*

Kind of graph	Number of groups compared
Object graph	Two categories are compared Three categories are compared
Figure chart	Two categories are compared Three categories are compared
Object graph	Four categories are compared
Figure chart	Four categories are compared
Symbolic graph	Two categories are compared Three categories are compared Four categories are compared

Being more tangible, figure charts could be a proper starting point for introducing graphs to children. Figures, instead of numbers, are shown in graphic representation. It is used to compare the sizes of various categories. Each figure used shows only one parameter or one group. A bar graph is a more concrete form of figure chart because numbers, now, start being used instead of figures. Bar graphs, too, are used for comparison as figure charts are (Olkun & Toluk Uçar, 2004). At the end of a study with 121 fourth grade and 127 sixth grade students on reading twelve different bar graphs, data interpretation, and estimation, Pereira- Mendoza and Mellor (1991) observed that 95 percent of fourth grade students and 98 percent of sixth grade students succeeded in reading data from bar graph.

It is very important, from the perspective of quality education, for teachers to know about the points that children have difficulty and make mistakes in the data teaching. These mistakes could be named as misreading, misunderstanding, carrying out incorrect math operations in translation procedures used for tables and graphs such as doing

multiplication instead of addition, making mistakes during operations and misinterpretations in problems related with data (Ryan & Williams, 2007). Koparan and Güven (2013) emphasizes that consistency in statistical thinking, relating, multidimensional thinking and presentation increase towards higher grades in their study in which they aim to define differences between class levels of students of various grades. From that it could be said that statistical thinking is related to cognitive development. On the other hand, it is seen that some sixth grade students show advance thinking in statistical thinking. Therefore, value of experiences students have had in development of statistical thinking skills is supported by the finding of the study. Also, one of the findings of the study is that seventh and eighth grade students could generally read tables, figures, and graphical presentation and recognized pieces of data but that almost half of the sixth grade students generally appeared at the first level. This situation brings it to mind that sixth grade students have had some problems in defining the data. It could be said that a successful data teaching period is possible by designing instructional environment and by instructing teachers who, depending on scientific sources, can develop this period. In primary schools, the foundation of the data analysis and its interpretation stands on the activities that are directed to students' being able to read presentations and being able to be aware of presentations. From this point of view, in the study, it is aimed to describe pre-service elementary teachers' experiences about data teaching process.

Method

This research is a descriptive study that aims to investigate lesson contents about first through fourth grade math lessons prepared by pre-service elementary teachers and experiences they obtained in primary schools they went as a part of teaching practice. Descriptive studies are researches in which obtained data are organized, interpreted, and presented to the readers and in which physical conditions or groups are described (Yıldırım & Şimşek, 2008; Büyüköztürk, Çakmak, Akgün, Karadeniz & Demirel, 2010). Descriptions of pre-service teacher experiences are targeted in the study.

Research Group

Table 2. *Teaching Practice Groups, Practice classes for groups, Sub-learning areas and lesson outcomes for the topic of data*

Pre-service teachers and practice classless	Sub-learning area	Outcomes
1A-1B	Table	The learners will be able to read tables
2A-2B	Object graph	1. The learners will be able to collect data about a problem and form a figure chart. 2. The learners will be able to interpret object graph.
	Table	Learner will be able to organize the data into a table.
3A-3B	Figure chart	1. The learners will be able to collect data about a problem. 2. The learner will be able to create a figure chart. 3. The learner will be able to interpret a figure chart.
	Table	The learners will be able to create tally and frequency tables.
4A-4B-4C	Bar graph	1. The learners will be able to create a bar graph. 2. The learners will be able to interpret a bar graph.
	probability	The learners will be able to use words indicating probability in proper sentences.

Nine fourth-year students attending a state university during the academic year 2013-2014 constitute the research of the study. These students were grouped so that they would practice on data-teaching topic in all classes of the primary schools they went. Pre-

service teachers were coded as A, B, and C according to the grade they practiced. These groups, the classes in which groups practiced, sub-learning areas of the topic of data and its outcomes are shown in table 2.

Colectıng Data And Theır Analysıs

Data collecting tools are consisted of semi-structured observation form prepared by the researches and lesson plans prepared by the pre-service teachers.

The observation form about data teaching is composed of four sub-sections. These sections are named as research question and the data (9 items), table (8 items), figure and bar graph (10 items), and supplementary explanations (6 items). The sections have contributed to create themes of the descriptive analysis. The themes have been dealt with under four titles as following and the findings have been presented in the way that each pre-service teachers' actions will be in these themes' coverage.

1) Research question and the data,

2) Table and graph,

3) Supply usage

4) The points at which difficulties have been experienced during the application or that explained incorrectly and incompletely

In the process, pre-service teachers were observed during one-hour-lesson by a researcher, and it is recorded by means of application period observation forms. At the end of the application period, lesson plans prepared by the pre-services teachers were collected from them to analyze. During the data analysis, observed experiences of each pre-service teacher were separately coded according themes defined in the observation form. All documents were analyzed by three researches separately for the reliability of the coding and after all researches reanalyzed the documents for the codes mismatched with each other, a consensus about the coding was reached by the researches. Direct quote were utilized to ensure the external reliability of the study.

Findings

Pre-service teacher: 1/A

Research question and the data. Doing his introduction of the lesson, the pre-service teacher had difficulty and failed to make a proper introduction. He had difficulty in drawing students' attention by saying "I will explain tables. You have already learned it before, so I start right now". He directly asked the research question to the students. Instead of taking answers of the questions, "Do you like colors?" and "What color do you like the most" from the students, he wrote four names of colors on the board and collected students' answers into these categories. Meanwhile, some children did not want to take part by saying "But I don't like these colors". After this activity, he asked, "What animals do you like the most?" and he brought four pıeces of cardboards with anımal pictures on them. Passing out smiley faces to the children, he told them to stick them on to the opposite side of the animal they liked the most.

Table and Graph. After passing out smiley faces to the children, he told them to stick smiley faces on the opposite side of the animal they liked the most. At this stage he encouraged students to collect data, but he drew the table himself. He did not make students do a table-reading study on the table drawn.

Supply usage. He passed out study papers about old Macdonald's farm. The study papers he had chosen had features of ready-made materials. They were photocopied material. The students had difficulty in following the material because they were first graders and

because reading-writing activities were still in progress. Study papers were not proper for first graders in terms of spacing and the font used.

The points at which difficulties have been experienced during the application or that explained incorrectly and incompletely. The pre-service teacher had difficulty in keeping class order because the students were at first-grade level. He conducted activities out of the lesson outcomes of the topic of data. The students struggled to understand. In the study paper activity, ready-made materials were used and it was not proper for the level of the class. Creating table activity was chosen instead of table-reading. He had difficulty in keeping the class in order during the activity of table creating because he did not include the students. He himself answered the questions on the study papers and then he asked the students to answer the questions individually. However, the students struggled to answer. It resulted in failure because the students did not know what and where to write. The lecturer of the teaching practice had to warn the pre-service teacher to go more slowly.

Pre-service teacher: 1/B

Research question and the data. He made an introduction to the lesson with a question gathered under three categories. He said to the students, "Let's find out who likes honey and milk in this class" and he did not pose it as the research question. He carried on the activity with questions like "Who likes milk? Who likes honey? How many of you like milk?" He did not do an activity like organizing the data and reflecting them to the tables.

Table and Graph. A table activity was presented about seasons. The pre-service teacher showed a table named "students who like seasons" by means of an overhead projector. He asked the students to analyze the table and made an introduction to the lesson by asking, "What season do you like the most? What season are we in now?" Afterwards, he carried on the activity with question like "According the table, what seasons are liked the most, what seasons are liked the least?" He used tables of maximum four categories. In the "my farm" activity, he presented a table with three categories by the overhead projector.

Supply usage. He presented activities as study papers and by overhead projectors. The tables that he used in the table-reading activities were correctly prepared. However, during his instruction on tables, the pre-service teacher carried on activities with routine questions rather than putting forward the relationships between the contexts of the data and tried to squeeze a lot of activity in one lesson. He could not execute the activities on time and the students did not want to take part in table-reading activities.

The points at which difficulties have been experienced during the application or that explained incorrectly and incompletely. Showing the pictures of lions, elephants and horses, he said, "These are animals living in my farm" One of the students said, "Lions and elephants don't live in farms, sir" He presented some table activities like "the most loved colors" and "the most loved animals". He tried to fit all activities in one lesson. After the first 20 minutes, he lost control of the class. The students did not take part in the lesson. He asked proper questions about the tables but the students were lost in the lesson because he did not give any feedback and did not make any relationships between the contexts of the data.

Pre-service teacher: 2/A

Research question and the data. He drew a smiley face for each male and female student and asked the number of girls and boys in the class. Asking, "I wonder what fruits are liked the most in this class", he tried to state the fruits liked. Both questions attracted the students' attention. The Children's most loved fruits were gathered under six categories. These are apples, bananas, water melons, coconuts, strawberries and grapefruits. He

ignored some preferred fruits. The students asked, "Why weren't ours picked?" The students raised their hands and stated the fruits they liked but he could not determine the number of fruits correctly because there were too many categories. The students did not collect data about the research question given.

Table and Graph. During the determination of the most loved fruits, he did not show the data on the table. He asked the students some questions on the data, which were not recorded. His questions were directed to conducting operations on questions. The questions like "How many of you do you think likes grapefruit and strawberries?" confused the students.

He created a figure chart, not an object graph, about the most loved fruits. He drew a picture of the every fruit that every student liked. The students did not take part in graph creating activities. He asked a few questions like, "What fruit is liked the most? What fruit is liked the least?" on the graph he created. He did not elaborate enough on the interpretation of the graphs.

Supply usage. No materials were used.

The points at which difficulties have been experienced during the application or that explained incorrectly and incompletely. Figure charts were used although object graphs were mentioned for learning outcomes of grades. He did not appoint any duties in collecting data and creating graphs. For that reason, along the lesson, students stayed inactive and he, himself, had difficulty to control the class. He did not do any activity for the lesson outcome: "The learners will be able to organize the data". And, for that reason, the students struggled to make sense of and to organize the data.

Pre-service teacher: 2/B

Research question and the data. He made an introduction to the lesson with the question: "What subject do you like the most?" He himself wrote the names of the lessons without having students' answers. He asked them to name the ones they liked the most among math, social science and turkish. Stating that the students confuse due to many categories, he limited, as a result, the categories to three. Yet some students persistently stated different names of the subjects too. He made a forecast graph for three days for the same reason. The students reacted by saying, "A week has seven days, not three. Why are we doing it like that, sir?"

Table and Graph. The students themselves did not collect the data and did not organize it into the tables. The pre-service teacher first drew the table for the most loved subject and, about the table he drew he asked the questions, "What subjects are the most loved? and What subject are the least liked?" He did not ask any question about the table he drew about the forecast. He wanted the students only to take notes in their notebooks. He never dwelt on concepts of variable and category on the table.

The pre-service teacher brought blue, green, and blue beads. He asked the students to fix the beads with the color they like to the stick they belonged. Some of the students said they did not like these colors and they did not want to fix them to the sticks. Yet, the pre-service teacher stated that they had to choose a color. The students mostly chose blue and there were no more blue beads to fix. Due to being not well-structured, the activity failed. Nevertheless, it was the only activity reflecting the outcomes of the figure charts and allowed the students to do classification.

Supply usage. The beads and the sticks to which beads were fixed were used.

The points at which difficulties have been experienced during the application explained incorrectly and incompletely. The pre-service teacher obliged the students to choose three

categories and to study them. He did not give any opportunity for them to collect data and to submit their proposal for research question. He did not allow for the interpretation of the graphs by using directing questions. In the activities with research question given, the students thought they had to determine the categories first because the determination of category activities was done with giving research questions and not giving an opportunity to answer.

Pre-service teacher: 3/A

Research question and the data. The pre-service teacher made an introduction by putting the table he had prepared beforehand the lesson on the board. Instead of making the students notice the research questions the table reflected, he started the lesson by saying, "Let's see what animals are there in old Macdonald's farm". The students did no activity about data collecting.

Table and Graph. The pre-service teacher asked the students, "Who drinks milk every day" and wrote the names of six students on the board. He showed them how to show with the tally method as an example. However, the students had difficulties because reading tally-table activities had not been performed. Correcting the wrong presentation, the pre-service teacher, himself, showed the correct presentations. Some students wanted to correct, but the pre-service teacher did not give them permission to speak. Tally presentations were emphasized, not the tally chart. He affixed some of the animal pictures on the cardboard he had brought. Stating that each picture he had affixed showed three pictures, he asked, "What do you seen on the board?" However, the students struggled to answer because the question was not clear. Later, displacing circles with the animal pictures, he followed a way from the concrete to the abstract. Changing the number of both animals and circles, he asked question like, "How many animals....? What is the most numerous animal? What is the least numerous animal?" and gave some students permission to answer. He called some students to the board and handed them some beads. He said every bead represented five beads and he asked the class to determine how many beads the students at the board had. Two students took part in the lesson and could calculate it, but the rest of the class could not work it out.

Supply usage. A pre-prepared cardboard on which animal pictures were to be stuck with the name of old Macdonald's farm were used as the material.

The points at which difficulties have been experienced during the application explained incorrectly and incompletely. The pre-service teacher asked them to make a bar graph with the beads they had in their hand. Not having created any figure chart well enough and not having seen bar graphs before, the students did not took part in the activity and the teacher dropped the activity. Presenting data on the tables was not elaborated well enough. He tried to cover all four lesson outcomes about tables and graphs in a single lesson. The students participated in the table creating activities by using their pre-knowledge. Activities about the outcomes were not covered completely.

Pre-service teacher: 3/B

Research question and the data. The pre-service teacher asked the questions: "What is tally chart? What is figure chart?" He wanted to check their pre-knowledge but the students had not seen figure charts and tally charts before. They could not answer. He showed the students a zoo and asked them to find out the number of animals. Thus, the students played a role in the process of collecting data. However, it was not stated as the research question.

Table and Graph. Moving from the visuals, the students worked out the number of animals. The pre-service teacher explained what the tally is and gave the students some

information about the presentation. He asked the students to write the names of the animals and to show the number of animals next to animal names as tally. The students successfully completed the tally activities. Following the tally chart activities, the pre-service teacher did not ask any question. The students did not name the table they created.

Moving from the table the students created about the zoo, he asked the students to create a figure chart as if the students had known the topic of figure chart. The students did not know what to do. Then the pre-service teacher, personally, drew it on the board. He did not give any information about graphs. When copying the table on the board to their notebooks, most of the students did not write the title of the table, not even record the names of the variables. Showing the figure chart of the liked football teams he prepared and asking questions on the graph, he did some table-reading activities. He proceeded graph reading activities with question like "What football team is the most supported? What football team is the least supported?" Each figure in the graph represented two figures. However, the pre-service teacher forgot to share this with the students.

Supply usage. A zoo picture and a figure chart named "supported football teams" were use as materials.

The points at which difficulties have been experienced during the application explained incorrectly and incompletely. The students behaved as if they did not know figure and tally charts. The pre-service teacher did not dwell on the concept of category. He started figure chart creating activities without conducting any activities like collecting data and creating graphs activities. Because he did not sufficiently emphasize the properties that graphs should bear, the students forgot the details such as naming the created tables and graphs etc. The visual of zoo was not clear. The students counted differently because it was a photocopy.

Pre-service teacher: 4/A

Research question and the data. The pre-service teacher asked, "What comes to our mind when we hear the word graph?" The students replied, "Tally charts, columns, bars, lines, figure charts". The pre-service teacher said "We use tally charts when creating graphs". He passed out candies with three different colors. Without stating the research question, he said, "Let's count the candies in terms of their colors".

Table and Graph. Making the students count the candy in terms of colors, he himself drew a tally chart on the board. Calling a student to the board, he asked to the student to write the number of pieces of candy next to the colors according to the tally graph. Created tables were named. Tally charts and frequency tables were created. The pre-service teacher made an introduction to graph creating activities without conducting any graph reading activities. He asked about the hobbies of the students. He wrote the hobbies of the students under five categories on the board. The pre-service teacher drew a bar graph in both horizontal and perpendicular appearance and asked the students to interpret the data according to the questions he would ask from the graph. He did graph-interpretation activities by asking questions like "How many of you are attending guitar course? What hobby is the most preferred one? What hobby is the least preferred one?"

Supply usage. He did not use any material. From a ready-made source, photocopied study papers were passed out to the students.

The points at which difficulties have been experienced during the application explained incorrectly and incompletely. The pre-service teacher wrote how many students there are in each category opposite to the hobbies in the graph about the hobbies he created. Axis names were not written. The title of the graph was not written either. A histogram was

drawn instead of bar graph. Saying, "This is incorrect", he corrected it. One of the students said, "Let's unite the columns, sir". The pre-service teacher replied, "Next time we will do it that way". Copying from the board to their notebooks, the children, too, made histogram-like drawings.

Pre-service teacher: 4/B

Research question and the data. The pre-service teacher asked, "How many of you are attending weekend courses arranged in your school?" The students gave answers; he himself recorded the data and created a table. He asked the students, "On what else subject shall we collect data?" The students replied, "Let it be about games and supported football teams", but the pre-service teacher replied, "No not them, let's collect data about the months you were born in". It is because he had prepared for that. The pre-service teacher had difficulty in determining a research question as an in-class activity.

Table and Graph. Collecting the data, himself, about the children attending weekend courses, he drew the tally chart and the frequency table himself. Afterward, he collected the data about the months the students were born in by asking them to raise their hand. One of the students wanted to draw the table. The student themselves drew the tally chart and the frequency table in accordance with the data. The pre-service teacher asked some question for table-reading. He asked the students, "In what month were the most of your friends born in?" There were four mounts in which the most births took place. One of the students said, "We haven't named the tables". The pre-service teacher named the tables. During table-reading, the students had difficulties because the categories on the table had not been named and because there were too many categories on the tables about the months in which the students were born in. Yet, they correctly answered the questions the pre-service teacher asked. Bar graph activities were not done for those tables.

The pre-service teacher had prepared a bar graph with the name "the most loved colors". He presented it by the help of an overhead projector. He had prepared a graph with four categories. He asked questions like "What is the most loved color? What is the least liked color? How many times bigger is the number of those who like yellow color than the number of those who like black color?" He explained the relationship between lines and columns on the bar graph. The students had difficulty in copying it from the board to their notebooks. They made some incorrect drawings. There were some students who drew bar graphs like a histogram. A table was drawn with the help of the data collected from the students about the football teams supported in the class. One of the students went to the board and drew a bar graph. He correctly set the relation between the columns and the lines. The students sitting in their desks examined what their friends did on the board and copied it in their notebooks. He asked, "What football teams are supported by the most and the least people?" He did not ask anymore questions directed for interpretation. The graphs were drawn horizontally.

Supply usage. He presented the activity named "liked color" by the help of a overhead projector.

The points at which difficulties have been experienced during the application explained incorrectly and incompletely. The pre-service teacher drew a table named Busra's academic success with four categories and he asked the students about the grades that Busra had got from the subjects. Then he said, "I will teach you the mean". He calculated the mean with the grades that Büsra had earned on the subjects. He explained how to work out the mean. He said, "We add the grades up and divide it by four". He told the student to calculate by changing the grades. The students struggled to calculate. He called a student to the board and explained how to work it out step by step. One of the students asked, "What is it for?" He said, "You will learn later".

Pre-service teacher: 4/C

Research question and the data. The pre-service teacher asked the students, "What should be eaten to get some vitamins in cold weathers?" The students replied, "Fruits and vegetables". The pre-service teacher asked "Who likes what fruits". After that, he showed the graph he prepared about the favorite fruits.

Table and Graph. He asked the students, "Who regularly brushes their teeth?" Then he said, "Let's make a table about it". One of the students asked, "Did you ask as days?" The pre-service teacher replied, "Yes". One the students added, "Let it be weekly; it could be difficult to show on the table otherwise". The pre-service teacher said, "Okay". The students told how many times they brush their teeth and the pre-service teacher himself drew the tally chart and the frequency table according to the data. He asked, "Who are those who brush the teeth regularly with respect to the table?" The students could not decide how to answer. The students asked the pre-service teacher, "How will we know if it is done regularly?"

Before the bar graph activity, the pre-service teacher showed the students the figure chart he had prepared about the most loved fruits. He added that each fruit represents three fruits. Then he started graph reading activities. He asked few questions like "What fruit is the most loved and the least liked ones? How many more fruits should banana lovers eat to catch apple lovers?" The per-service teacher took a different number of beads, in five colors, in his hands. He said, "We will draw a bar graph with respect to the number of these beads". He wrote on the board that each bead represents three numbers. The pre-service teacher drew a bar graph considering the number of beads in his hands. He explained how to draw the graph. He asked the students to take some beads in their hands and to draw a bar graph with respect to the number of the beads. The students struggled to align the numbers on the perpendicular axis because the teacher had not explained the relationship between lines and columns in the graph. The pre-service teacher called a student to the board and instructed him to draw the graph. He emphasized only the points at which the student at the board had difficulty in. He did not check the graph of the students who were sitting.

Supply usage. The most loved fruits board prepared by the pre-service teacher was used as the material.

The points at which difficulties have been experienced during the application explained incorrectly and incompletely. Not naming the tables and graphs, the pre-service teacher sometimes forgot to name perpendicular and horizontal axes. Most of the time, the students reminded him. Instead of encouraging the students to create graphs, he asked them to answer the questions for which they can work out in their head on ready-made tables.

Conclusion and Discussion

When analyzing the lessons pre-services teachers prepared and the data about application samples, it could be said that pre-service teachers are not knowledgeable about the topic of data teaching. During the lesson presentations, it was observed that the pre-service teachers struggled, got bored, and asked for help from the class teacher. Pre-services teachers have difficulty in realizing an effective math period with the increase in their level of concern (Swars, Daane, & Giesen, 2006). It has been noticed that especially pre-service teachers who did teaching practice in grade 3 and grade 4 were sometimes criticized and their mistakes were corrected, again, by the students. For example, when one of the students asked, "What is it for?" the teacher coded as 4B could not answer the question and said, "You will learn later". When analyzing the pre-services teacher's

practice teaching, one of the attention-drawing points is that it has been observed that the pre-service teachers dealt with outcomes that were outside of the class outcomes. Although the arithmetic mean was not a topic of the grade-four level, the pre-service teacher presented an example about calculating mean and pre-service teacher 4/B, directly giving the rules for the solution of question by saying, "Add up the grades and divide it by four", carried out the solution of the problem.

It was seen that pre-service teachers are not completely knowledgeable about the concepts of category and variable in table and graph activities. In some examples, too many categories, over the class level, for the variable were determined and for that reason the students had difficulty in organizing the data. Again, the pre-service teachers did not name the tables, graphs and the axes in the table and graph activities. Some pre-service teachers, either, did not ask about the students' ideas in the activities of category determination and so, the students showed reluctance for taking part in the activities. Sometimes, the students warned the pre-service teacher or told the activities that could be done and the pre-services teachers did activities in the same direction accordingly. For example a pre-service teacher who, using too many categories, struggled shared his experiences with another pre-service teacher named 2/B and 2/B limited the number of categories in the activities. Teaching practice opportunities for pre-service teachers becomes more effective with their natural sharing experiences in teacher-student and teacher-teacher interactions. The pre-services teachers' positive opinions that they can effectively teach the topics in the first grade level show that experiences acquired in real class contexts have very important effect on their pedagogical development.

At the stages of collecting and organizing the data, it was observed that pre-service teachers themselves did the works in the class instead of instructing the students to do. Posing the research question to the class, after collecting the data of the class about the research question from the students, some pre-service teachers organized the data either by themselves or with one or more students. The students who were sitting at their desks took part in the lesson by observing and copying what was done on the board made mistakes. It is thought that pre-service teachers see themselves, not the students, at the center and for that reason they could not do a lesson in accordance with constructivist approach. When the number of teaching practice and their duration increase, it could be said that pre-service teachers will realize lessons in which student are more active and that the way they do their teaching practice will change. In the lessons that elementary teachers will do about the topic of data, they should try to take care to:

a) Use real data;

b) Present good examples about the topic of data;

c) Ensure that students are active in all stages in the topic of data (Franklin et al., 2007).

During a single lesson more than one table and graph activities were done and, as a result, the lesson outcomes that wanted to be acquired was overlooked. It was seen that pre-service teachers did not well enough emphasize table and graph reading activities. Defining the data is something beyond roughly-reading the information exists on the tables and graphs. Reading the data is to see the information on the data representation without having any difficulty, to understand the given graph, and to make sense of the data in its context (Curcio, 1987). Koparan and Guven (2013) highlighted that since activities which are directed to primary school students' being able to be aware of the data presentations and being able to read some certain data from data presentation will set the foundation for the analysis and the interpretation of the data, these activities need to be done. For example, during table activities, activities in which one figure represented a few

figure were carried out in the class but the pre-service teachers did not dwell on these activities in both table and graph activities. In table-reading, and table and graph interpretation activities, they rather preferred to instruct the student to study with questions directed to making operations instead of questions that would direct the students to interpret. In the conversations with the pre-service teachers after the teaching practice lessons, the pre-service teachers stated that they did not know what to ask, that there were exercise questions in the sources as routine so they mostly preferred to use these kinds of questions and that they became quite anxious.

In the lessons, the pre-service teachers used the overhead projector, study papers, ready-made cardboards for presentations, and the board as materials. Especially in collecting data and object graph activities, real objects, too, like beads, sticks, and candies are among the examples of material usage. Pre-service teachers did not do any activity in the computer environment although there were computers in the classes they did teaching practice.

It has drawn attention that in figure chart activities in the second-grade level, the pre-service teachers perceived figure charts as object graphs. Doing figure chart activities instead of object graph activities, the pre-service teacher 2/A did not include the students in the data collecting process and carried out the lesson with ready-made activities. 2/B brought blue, green, and red beads and wanted the students to fix the beads with the color they like to the sticks. Saying,"Are there only these colors? I don't like these colors", some students said they did not want to fix the beads, but the pre-service teacher said they had to choose a color. Nevertheless, the activity worked out successfully because a natural figure chart activity was realized and the students were active in the activity. Without having done figure chart activity well enough, the pre-service teacher 3/A attempted to do a bar graph activity in, again, grade 3 level but the students had difficulty in placing the number in sequence on the perpendicular axis and in naming the axes in the activity. One of the hardships experienced in the graph activities was encountered in bar graph activities in grade 4 level. Difficulties were experienced in graph creating activities because of not having adequately done bar graph activities and because of the conducted activities in which teachers were active while the students passive. For example, copying already-drawn bar graphs on the board to their notebooks, those who made drawings similar to histograms drew attention. Meanwhile, it was seen that the pre-service-teachers did not have any information about the differences between bar graphs and histograms. For example, in bar graph activities, the pre-service teacher named as 4/A drew horizontal and perpendicular axes and created the graph according the data given. However, names of the axes and title of the graph were not written either. He drew a histogram for a bar graph and later corrected it by saying, "This wouldn't do". One of the students said, "Let's unite the columns" but the pre-service teacher replied, "In the next one, we will do it". Copying from the board to their notebook, the children, too, made some drawings similar to histograms. That the pre-services teachers did not know about the differences between bar graphs and histograms caused the students to incorrectly learn and to make incorrect drawings. Bar graphs and histograms are very similar in appearance. Columns are used to show frequencies belonging to the categories in both kinds of graph. The difference between bar graphs and histograms is the kind of data being used. If the numbers representing categories are continuous, or if the numbers are able to be regrouped in different intervals, histograms can be used. If the data are non-continues, bar graphs can be used (Musser, Burger & Peterson, 2008). That pre-service teachers know basic concepts in the topic of data is important from the point of view that they should be able to prevent students from incorrectly learning.

Completing the process with favorable and useful experiences, very few pre-service teachers who worked with a lecturer and a teaching practice teacher who was enthusiastic, eager, and conscious of his duties mentioned the experiences they had in the real learning environment and about the feeling that they felt themselves like a real teacher (Eraslan, 2008). In this study, too, in the assessment study that pre-service teachers did with the teaching practice teachers after the lesson, they stated that they remembered the explanations done in the scope of "Math Teaching" course and that, preparing to teach the students the topic of data in the practice school, they revised what they learnt in the lessons but they struggled, failed to put their knowledge into application, and, made mistakes during the lesson in the class environment. The pre-service teachers expressed that they benefitted from the activities about the topic of data along the teaching practice process and from the assessments done after the lessons. Moving from these results, it could be said that "math teaching" course has an important place in pre-service teachers' pedagogical development and that, for that reason, the lecturers should show sensitivity in the execution of the lesson.

In the education of elementary teachers who will set the foundation for math topics and concepts, the importance of "math teaching" course and the lecturer executing the lesson are obviously seen. Pre-service teachers' practice teaching processes should be analyzed in not only the topic of data but also other math topics too, and the results, meeting the deficiencies, should be shared with pre-service teachers.

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