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Impacts of Inquiry-Based Laboratory Experiments on Prospective Teachers' Communication Skills

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ABSTRACT

This research project aims to improve the communications skills of prospective teachers by using inquiry-based laboratory experiments (IBLE). The prospective teachers (n = 78) received theoretical training on inquiry, nature of science, and communication skills in the first term, while 40 experiments were carried out by inquiry-based learning applications in the second term. A mixed approach was applied by using a scale for assessing communication skills as both a pre-test and a post-test to obtain quantitative data, whereas 5 interview questions were used to obtain the qualitative data. There was a statistically significant variation between the pre-test and post-test communication skills scores (t (78) = 5.83, p < 0.00), which they indicated being patient, listening to each other, reducing prejudice, being respectful and knowing each other as learned and improved skills. The same students, however, had problems such as a lack of a sense of responsibility, insufficient concept-related theoretical knowledge and problems about task sharing, writing reports and getting jobs completed on time.

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Keywords:
communication skills, inquiry-based learning, science teaching, collaborative learning

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Introduction

Innovation, creativity, sustainability, information societies, technology, social media, digital word, and globalization are the most popular terms of 211st century. Under the influence of those terms, many societies such as China, South Korea and Japan showed rapid shift and transition reflecting their outputs on their economic growth rate. The main structures which cause the success of changes in the countries are political, cultural, historical and social-related. This could be added to modifications in their education systems including curricula, teachers' education, reconstructed school environments and utilized resources. Those changes are clearly reflected on their academic success in the international exams like TIMMS and PISA. This methodology is applied in the majority of developed countries.

Having low scores in science and mathematics by students, the National Research Council reviewed the science and mathematics standards for the sake of future jobs based on 21st century skills such as problem solving, innovation, collaboration, creativity, science literacy, technology literacy, realization of globalization and communication skills (NCR, 2012, Rotherham & Willingham, 2010). Turkey took similar steps on this direction. However, the scores were also lower than expectations in the TIMSS (2011) science and technology exam in which the fourth graders from 50 countries took part. Yet, despite the global reforms in almost every field of science education, educators haven't received needed training for them to be competent enough to take up their mission. The content knowledge, multidisciplinary connections, teachers' pedagogical attitudes, behaviors and communication skills of teachers are the aspects to be put under focus. In this

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research, prospective teachers practicing inquiry based, laboratory experiments enhanced their communication skill for the benefit of the upcoming generation.

Inquiry-based laboratory experiments

During the 1990s, science course practices came out of the classroom and laboratory with students' social environments gaining importance along with the fact that such practices improve students' critical thinking and communication skills and motivate them pedagogically (Duschl & Grandy, 2005). 1989's Project 2061 (Science for all American: AAAS) aimed to identify certain criteria for training science literate students, an objective that was achieved in 1996 with the National Science Education Standards (NSES, 2000). The standards were designed to help students acquire the ability to learn and understand the natural world and science; to use scientific processes to make individual decisions; and to use their science literacy skills to increase their productivity in their individual careers. At this point today, students learn new science concepts and gain critical thinking and communication skills while they search for their own solutions to a problem or a question (NRC, 1996). As one of the three dimensions of the framework, Scientific and Engineering Practices include asking questions (for science) and defining problems (for engineering), developing and using models, planning and carrying out investigations, analyzing and interpreting data, using mathematics and computational thinking, constructing explanations (for science) and designing solutions (for engineering), engaging in arguments from evidence, obtaining, evaluating, and communicating information (NRC, 2012, p.16). Bereiter and Scardamalia (2006) indicated that IBLE does not only include learning content, but also ensures the learning of softer skills. The softer skills were determined like epistemic practices, self-directed learning, and collaboration that were not measured on achievement tests (Hmelo-Silver, Duncan & Chinn, 2007). During IBLE, students should ask questions, produce hypotheses through discussions, research data, observe events, decide on experiment design with the group members, organize roles in the experiment group, write reports, and present the results. This was indicated through many dimensions (NRC, 2012, p.60): Communicating in a written/spoken form is another fundamental practice of science; it requires scientists to precisely describe observations, clarify their thinking, and justify their arguments.

Communication skills for teachers

Despite the availability of many outcomes of laboratory experiments for students, we tried, in this research, to find out about the effectiveness of inquiry-based laboratory experiments in science lessons in order to improve the communication skills of prospective teachers. The roles of teachers and schools are changing and so are the expectations about them. For instance, teachers are asked to teach in increasingly multicultural classrooms, integrate students with special needs, use ICT for teaching effectively, engage in evaluation and accountability processes, and involve parents in schools (OECD, 2009). Furthermore the OECD (2011) survey noted that teachers need to help students acquire not only the skills that are the easiest to teach and the easiest to test but more importantly, ways of thinking (creativity, critical thinking, problem-solving, decision-making and learning); ways of working (communication and collaboration); tools for working (including information and communications technologies); and skills around citizenship, life, career, personal and social responsibility for success in modern democracies. The use of effective communication skills is an important interpersonal competency which involves the ability to have an effective engagement in complex interpersonal interactions and to efficiently use and understand people. People in an interpersonal relationship tend to influence each other, share their thoughts and feelings, and engage in mutual activities (Erozkan, 2013). Effective teachers can take complex case and present it in a way that can be easily absorbed by students utilizing different verbal and non-verbal communications (Prozesky, 2000). Teachers, students, and scientists can all benefit from collaboration providing unique opportunities for each other and fulfilling some of the challenges that exist in their individual positions (Brooks, Dolan & Tax, 2011). Communication skills, including active listening skills, writing skills, effective speaking, and communication with students, families and colleagues are important competencies for teachers to improve themselves in their professional life and their own personal happiness. In countries like Turkey with multiple ethnic groups, the birth place of people may sometimes cause certain behavioral prejudices. Teachers, as we know, play a major role in reducing prejudices, gaining values, reducing sensitivity to environment, having positive attitudes in many fields, and providing good role models for communication with peers and students. Here comes the question: Which communication skills teachers should have?

Teachers need excellent communication skills to succeed in their profession. Listening, interpersonal, written and oral communication skills are to be existent in teachers to facilitate the understanding of teaching materials, as well as to have the ability to take their responsibilities effectively (Ihmeideh, Al-Omarı & Al-Dababneh, 2010). Students tasks are not only restricted to grasp the academic content, but also extent to the need to know how to keep learning, making effective and innovative use of what they know throughout their lives. Learning and thinking skills are comprised of the following: Critical thinking and problem-solving skills, communication skills, creativity and innovation skills, collaboration skills, contextual learning skills, information and media literacy skills. Good teachers have always incorporated life skills into their pedagogy. Life skills include leadership, ethics, accountability, adaptability, personal productivity, personal responsibility, individual skills, self-direction, and social responsibility. Prozesky (2000) explained the importance of communication skills by emphasizing that effective teachers are always effective communicators. They communicate clearly about course objectives, content and testing, making sure to provide a rationale for learning particular material and adapting instruction to their student's level of knowledge and skill. The lack of communication means that the students will not understand key concepts at all, or they will complete them incorrectly.

Functioning of an individual in society requires some degree of social competence. All people have some form of that competence, but different people have their social competences in different areas. A group, however, requires different skills than those required by individuals. It does not necessarily mean that an individual who is outgoing in a group will have high social competences in all situations. Mannberg (2001) and (Herlitz, 2001) defined social competence as a skill, rather than as a personality characteristic and actively listening to others, being able to express who he/she is, what he/she needs and thinks, working on a team and collaborative skills, loyalty, handling conflicts, problem solving ability, liability, and the ability to deal with changes were defined as social skills for new employers (as cited in Life Long Learning Programme, 2012, p.6-7). In many studies conducted with university graduates, students stated they continued to have problems with writing and oral communication skills (Gray, 2010). This necessitates incorporation of listening and writing skills in universities curricula (Henderson, 2001; Albrecht & Sack, 2000; Simons & Higgins, 1993). Moreover , recent studies have shown that the communication skills learned through workshops, video records, training environment, effective learning environments like roleplaying and direct application with examples rather than didactic education are transferred to the behavior of the trainer like doctor and nurses (Heaven, Cleg & Maguire, 2006; Wilkinson, Perry & Blanchard, 2008; Manee, Khouiee & Zaree, 2011; Jackson & Back, 2011; Mccarthy, O'Donovan, Twomey, 2008; Sergeant, Macleod, Murray; 2011). Most of the curriculum and assessment tools about communication skills are inappropriate or are insufficient for practical use by students. They should be flexible depending on the characteristics of the specific applied environment, such as the social structure of society where schools or hospitals exist (Makoula & Schofield; 1999). Students additionally found that the conceptual learning of communication skills in class was not easy to transfer to their jobs as teachers. In addition to communication skills, in the new global modern world, teachers should communicate with many different work groups, each of which is of unique cultures and religions, or even work with foreign teachers to achieve success in some projects. Mezote (2011) explains this as a cross-cultural communication experienced by agronomy students in foreign language lectures to prepare students for the business environment. Pineteh (2012) used virtual interactions in a communication class at Cape Peninsula University of Technology (CPUT)-South Africa with 180 students over the course of one year. The study demonstrates how synthesizing virtual and other computer-assisted exercises, as well as traditional classroom-based activities, can enhance both the teaching and the learning of communication concepts. Manee, Khouiee & Eghbal (2015) investigated the effectiveness of teaching life skills including stress management, self-consciousness, and effective communication on the general health of freshmen in a group of 100 students by using a general health questionnaire as a measurement tool. They found out that total scores achieved in effective communication skills resulted in better improvements in comparison with the other two instruction types. Five hundred eighteen professionals representing over 20 health professions attended 17 workshops, with significant difference obtained at the end of workshops between pre and post test results in the research of Sergeant, Macleod and Murray (2011). Ciftci and Taskaya (2010) found a statistically significant relation between the self-ability and communication skills of prospective primary school teachers.

Significance and problems of research

The study involves the application of an exemplary method to resolve certain problems in social and cultural communication skills by trying to improve communication skills through the use of inquiry-based experiments, rather than the provision of a theoretical class in science education. In this research the main problem was whether performing inquiry-based laboratory experiments in science lessons improve the communication skills of prospective teachers. The specific questions of the study were as follows: 1) Is there any significant difference in the communication skills of prospective teachers before and after the science experiments? 2) Does the particular high school they graduated from (public or private) have any effect on the communication skills of prospective teachers? 3) Which communication skills did they acquired or develop during the applications? 4) What were the difficulties experienced by the participants during the applications? 5) What are the reasons for the difficulties in their experiences?

Method

Research Design Model

A mixed method with explanatory design has been applied in the research. The mixed method is focusing on collection and analyzing of both qualitative and quantitative data in one research and a series of research (Creswell and Plano- Clark, 2007, p. 5). In explanatory design, qualitative data are required to explain quantitative data in details and to elaborate general results or research (Plano-Clark, Huddleston-Casas, Churchill, Green and Garrett, 2008). In the research quantitative part, a scale was used as pre-test and post-test to assess the changes in the communication skills of participants as a result of scientific inquiry experiments. A group of 78 prospective teachers was split into three classes as an experimental group. Research was conducted using the pre-test/post-test model (Frankel, Wallen & Hyun, 1993, p. 272). At the end of research, the qualitative data, instead of general data about the communication skills of prospective teachers, was used to reveal the acquired or improved communication skills. On the other hand, certain interpretation-needed problems were identified during the application process and the applications were discussed with further implications of the research. To obtain qualitative data, five interview-based questions were asked to the 74 participants (4 prospective teachers in sample group didn't attend this part) at the end of the application process. The questions were:

1- What did you learn during these applications?
2- What were the common difficulties of these applications?
3- What were the disadvantages of applications?
4- Did you do similar experiments during your own primary school stage?
5- In which lessons did you conduct experiments in high school?

Participants

The research was conducted with 2nd-grade prospective teachers of elementary education (n=78) attending Science and Technology Education lecture. 8 of the participants were males (11.39%) and 70 were females (88.6%). 36 individuals (45.6%) graduated from private high schools, while 43 (54.4%) graduated from public schools. All of them were participated in both qualitative and quantitative parts. But interview could not be made with 4 of them.

Application

Participants received theoretical training on the kinds of experiments, scientific process skills, inquiry, scientific thinking, writing laboratory reports, the nature of science, and the evaluation of laboratory activities in science education lectures during the fall semester. The research continued for 14 weeks during the spring semester. At the beginning of the second semester, conceptual knowledge about interpersonal communication skills and prospective teachers' communication skills were introduced using short video clips and PowerPoint slides. Communication skills have been taught using many different techniques such as teaching communication skills to advanced learners by means of applying different types of role-play, feedback, and debriefing (Jackson & Back; 2011). In this research, communication skills were introduced to

prospective teachers as soft skills through inquiry-based science laboratory activities. Laboratory activities help students acquire various skills including knowledge acquisition skills, organizational skills, creative skills, manual and communication skills (asking questions, discussion, explaining, reporting, writing, criticizing, and graphing), conceptual learning and teaching (Russell & French 2002; Trowbridge, Byee, & Powell, 2004; Blanchard, et al. 2010; Akben & Koseoglu, 2010).

The prospective teachers were divided into groups of 4 or 5 members in each class. The task of each member was identified as leader, assistant, reporter, technician, and presenter for the collaborative effect of inquiry (Luckie, Maleszewski, Loznak & Krha, 2004). If the group members were 4, assistant was neglected. By the help of inquiry-based collaborative learning , students learn cognitive learning strategies (Salovaara, 2005), influence their learning being active and explaining to each other (Hatton & Scholer, 2008), all of which improve effective professional development of teachers (Darling-Hammond & Richardson, 2009). Even though this model improved communication skills by expanding the range of thinking without causing stress among friends or dominating the groups with one student's idea, it still put pressure to control the responsibilities of each other. All students received the same marks from each experiment. The four experiments completed each week were conducted under the supervision of the researcher. The leadership group was in charge of preparing all the laboratory materials and asking questions from daily life to groups, while the other groups were trying to answer the questions by conducting experiments. Each week the leader group directing the experiments was changed so that each group held the responsibility. At the end of the week (Friday), each group presented the experiment reports to the researcher. The experiment reports were evaluated by the researcher and the members in each group shared the same mark. During each experiment, the student groups held different responsibilities such as leader, reporter, technician, and presenter. When all group members had experienced taking all the tasks, the members were changed among the groups. In total, 40 experiments about light, electricity, nutrients, force, magnetism, water, space, the human body systems, matter, photosynthesis, respiration, plants, animals, water, hereditary, and ecosystem were applied to each of the 3 sections. Because of their general study and attendance habits, the students were granted a single class absence.

Assessment Tools and Analysis

At the beginning of research, demographic information including the students' gender and types of their high schools was collected and the Scale of Evaluation of Communication Skills developed by Korkut (1996) was applied to research groups as a pre-test. At the end of all applications, the same scale was applied as a post-test to find answers to the following research questions: Is there any significant difference in the communication skills of prospective teachers before and after the science experiments? Does the particular high school they graduated from (public or private) have any impact on the communication skills of prospective teachers? The scale contains 25 items such as, *I listen to others without any prejudice, I can see events from different perspectives, I take care about my responsibilities to improve relations with others.* It was an indicated on a five-point Likert scale: 5 = always; 4 = too often; 3 = sometimes; 2 = rarely; and 1 = never. The maximum score on the scale is 125, while the minimum possible score is 25. The assessment tool had been administered to college students with its reliability and validity verified with a Cronbach Alpha reliability of 0.80. In this research, the Cronbach's Alpha reliability was found to be 0.76. Independent t test, dependent t test, and frequencies were used in data analysis. The significance level was chosen as $p<0.05$. Most of the curriculum and assessment tools related to communication skills are either inappropriate or insufficient for practical use by students. They should be flexible depending on the characteristics of an applied environment like the social structure of society where schools or hospitals are found (Makoul & Schofield; 1999). In fact, there is a rich literature on the discussions dealing with the assessment of communication skills. Using specific assessment tools depending on the desired types of communication behavior is commonly accepted by scientists in this field. For instance, very few communication assessment instruments in medical education focus on gender. The criteria for and purpose of assessing gender in communication skills in medical education have yet to be clarified (Dielissen, Bottema, Verdonk & Lagro-Janssen, 2011).

The responses given in the interview were analyzed by content analysis (Yıldırım & Simsek, 2008) with the help of two experts in science and communication. First we encoded participants like GRu1, i.e. a girl graduated from public school; and GPr1, i.e. a girl graduated from private school. The same encoding was done for male prospective teachers like MPu1 or MPr1. Then we encoded the answers of 5 constructed

questions (Strauss & Corbin, 1990) into 3 themes. Theme one was communication skills acquired and developed during the research applications. Theme two was communication problems of prospective teachers. Finally, theme three was the reasons of problems in communication skills and difficulties of inquiry-based laboratory experiment applications. In fact theme three was subdivided into 2 parts at the beginning, but later we decided to put them into one theme because of their direct connection with each other. The answers were encoded and any discrepancies were discussed until an agreement was reached. Inter-coder reliability analysis was implemented on the obtained themes. Codes and themes identified according to this comparison results were found to be 95% similar. For reliability, the formula which is Reliability = Consensus / Consensus + Dissidence X 100 is applied on the encoding made by researchers and readers (Miles & Huberman, 1994).

Findings

This part demonstrates the results of quantitative part including those of pre-tests and post-tests and results of qualitative part of research related to interviews.

Table 1. Results of t-test on pre-test and post-test communication skills of prospective teachers

	n	$\bar{X}$	sd	t	p
Pre-Test	78	99.40	10.92	5.83	0.000*
Post-Test		106.39	8.67		

*p<0.005

In order to test the differences between the pre-test and post-test communication skills scores of prospective teachers, a t-test analysis was conducted. The results showed that there was a statistically significant difference between the pre-and post- test communication skills scores of prospective teacher (t (78) = 5.83, p < 0.00).

Table 2. Result of the t-test on pre-test and post-test communication skills of prospective teachers graduated from private high schools

	n	$\bar{X}$	sd	t	p
Pre-Test	42	101.88	9.26	3.296	0.002*
Post-Test		107.07	7.27		

*p<0.005

In order to test the differences between the pre-test and post-test communication skills scores of prospective teachers who graduated from private high schools, a dependent t-test analysis was conducted. The results showed that there was a statistically significant difference between the pre-and post- test communication skills scores of prospective teachers who graduated from private high schools (t (42) = 3.296, p < 0.002).

Table 3. Result of the t-test on pre-test and post-test communication skills of prospective teachers graduated from public high schools

	n	$\bar{X}$	sd	t	p
Pre-Test	36	94.9	11.83	4.61	0.000*
Post-Test		105.6	10.4		

*p<0.005

Depending on table 3, there was a statistically significant difference between the pre-test and post-test communication

skills scores of prospective teachers graduated from public high schools (t(36)= 4.606, p < 0.00). According to the pre-test results, the communication skills of prospective teachers graduated from private high schools are greater than their counterparts graduated from public high schools. After research applications, prospective teachers graduated from public schools reached approximately the same level of communication skills as the prospective teachers graduated from private high schools even if their communication skill levels increased.

Results of content analysis of interviews

Table 4. Brief results of qualitative data analysis

Codes for participants	**Themes 1 and codes** **Acquired/developed communication skills**	**Theme 2 and codes** **Problematic areas in communication skills**	**Theme 3 and codes** **Reasons for difficulties in both communication skills and applications**
*GPu 1: Girl graduated from public school and occupied the first order in the lecture list. *GPr 78: Girl graduated from public school and occupied the 78th order in the list *MPu1: Male graduated from public school *MPr 32: Male graduated from private schools and occupied the 32nd order in the list	*KE: Knowing each other (n=37) *BP: Being patient (n=28) *BR: Being respectful (n=15) *CR: Forming close relationships within the same group (n=14) *EP: Eliminating prejudices (n=13) *LE : Listening to each other (n=13) **Developed personal skills other than communication-related ones:** *TR: Taking responsibilities (n=27) *EJ: completing the job on time (n=25)	*LC: Lack of communication with group members (n=14) *IL: Ineffective listening (n=9) *NC: Negative communication language (n=8) *IC: Irrelevant chatting (n=4). **Personal skills that caused problems other than communication-related ones:** *TR: Being aware of the different responsibilities of each group member (n=35) *CD: Making common decisions (n=29) *DP: Dominant personalities (n=24) *DT: Distribution of tasks (n=13) *LR: Ending the tasks, particularly experiment reports, on time (n=10) *CM: Students not caring about marks (n=7) *LB: Sharing of lab materials (n=5).	*TR: Sense of responsibility (n=58) *IN: İnsufficient knowledge about the units (n=47), *NE: No experience before the applications (n=22) *NM: Not caring about marks (n=19) *WG: Working as a group (n=16) *LR: Writing laboratory reports (n=8) *CA: Compulsory attendance (n=7)

Theme 1: Communication skills acquired and developed. The new communication skills identified by the participants include knowing each other (n=37), being patient (n=28), being respectful (n=15), forming close relationships within the same group (n=14), eliminating prejudices (n=13), listening to each other (n=13). Below there are some examples extracted from the interviews.

GPr 56 KE-LE-EJ: At the onset of the experiment, I didn't know any member of the group I was in, thinking that I could not communicate with the other two girls. Soon, however, I realized they we have many things in common and we were doing the jobs on time. Therefore, we didn't have any problems. Being

girls, we kept speaking a lot simultaneously, the thing which affected our decision-making. Later, we learned to speak less and listen more to each other.

GPu 63 KE- CR: In our department, we were 90 students in total but I had already known 4 or 5 girls for 2 years. Now I have many friends and I am sharing knowledge with them not only regarding this lesson but also other issues that could be useful to me.

GPu 45 EP-CR: I had a problem in my first group because nobody did the job on time and no one cared about the marks. I asked you to change my group, but you didn't respond to me, telling me to express all my points of views about group members to them respectfully without any judgement; and to explain the way I want to work with them in a step to try to solve the problems among us. I followed all your pieces of advice clarifying to them why the grades on the reports were important to me. Thus, we found new ways and rules to help us finish the laboratory reports on time. Later on, we carried out very successful experiments.

MPu 55 BP: All of our group members were girls. This means we spoke too much and we were usually stopped to allow others to speak. In this lecture the most important thing I learned was being patient when someone speaks. It also taught me that some of us were too slow in conducting experiments. I tried to control myself and be patient without interfering. What is more, this lecture prepared me for the life outside the university.

In the samples, being a multicultural society meant that prejudices had to be restricted in order to start a positive system of communication like speaking, listening, observing the researcher's body language, and the voices of others. At the beginning, there were some problems such as having too much noise in the classroom and many complaints from the subjects. Later on, they explained that taking responsibilities (n=27) and completing the job on time (n=25) became easier as they learned better communication skills. In fact, these aspects were not included in the communication skills in as much as in group work. In fact, taking responsibilities and ending the job on time are very important factors that affect the communication between group members. The realization of the importance of these two factors for the self-improvement of personal skills was one of the most significant outcomes of the applications. In fact these traits must be cultivated in childhood and reinforced throughout the education process.

Theme 2. Problematic areas in communication skills. The answers provided by the participants have been classified as communication skills and personal skills. The communication problems were as follows: Lack of communication with group members (n=14), ineffective listening (n=9), negative communication language (n=8), and irrelevant chatting (n=4). The personal skills leading to communication were identified as: Being aware of the different responsibilities of each group member (n=35), dominant personalities (n=24), making common decisions (n=29), distribution of tasks (n=13), ending the tasks and particularly experiment reports on time (n=10), students not caring about marks (n=7), and sharing of laboratory materials (n=5). (Samples are given below).

GPu13 LR-CM-TR: The members in charge of completing the experiment report were a problem. They prepared it in the last minute before deadline. This made the report as mess, with all the group members received low marks.

GPu 28 CM-TR-DP-IL-CD: Some people took no responsibility for doing the tasks on time, and worse, they didn't care about the marks. Since the group leader had a domineering personality, we did not have a chance to decide on a common procedure for the experiment. She didn't listen to anyone rejecting all the ideas from the rest of the group. So, changing the tasks for each experiment was a good idea.

GPr11 LB: I had a big problem and was surprised about the sharing of materials between groups. They didn't realize that the owner of materials was the university and some friends irritated me by behaving impolitely.

Theme 3. Reasons for difficulties in both communication skills and applications. The prospective teachers mentioned disadvantages such as sense of responsibility (n=58), insufficient knowledge about the units (n=47), lack of experience before the applications (n=22), carelessness about marks

(n=19), working as a group (n=16), writing laboratory reports (n=8) and mandatory attendance (n=7). The participants of zero experience about laboratory experiments had lots of difficulties. "I don't know the names of many of the laboratory materials or how to use them," a student of GPu26 NE-IE stated. Furthermore, they had some problems with certain concepts like MPu 47 IN-NE:"I had not known anything about electricity before so I had some difficulties conducting the experiments." The reasons for these problems can be explained by analyzing the answers to the questions in the interview. Did you do experiments during primary school, and in which lessons did you do experiments in high school? 30 participants (%38.5) affirmatively answered the first question. Whereas the answer to the question "why did you do experiments?" included the following: We had a laboratory (n=16), my teachers liked to do experiments (n=8), or we did demonstration experiments (n=6). 61.5% of the participants (n= 48) replied negatively to the question, indicating reasons like the lack of laboratory (n=20), my teacher didn't want to do experiments (n=17), no materials were available at school (n=5) or too many students in the class (n=5). Concerning conducting experiments in high school, their answers followed a similar pattern: 33.3% of the participants (n=26) said "yes" with these details: Only in chemistry lessons (n=10), only in biology lessons (n=4), only in physics lessons (n=3), in the three subjects (n=3) and in chemistry-biology lessons (n=5). 53.8% of participants (n=42) answered "no", indicating that teachers didn't want to do experiments (n=15), we had no science lectures (n=7) or there was no laboratory (n=8). In fact all of them had lectures on general biology, physics, mathematics, and chemistry one year ago; however, 47 of them stated that they had insufficient knowledge of the units. These qualitative data demonstrate that prospective teachers might have some communication problems in a group or team, they might lack enough qualification or competence such as motor skills, content knowledge, practicing abilities, usage of materials, writing skills in their concerned field.

Discussion

Inquiry-based learning combined with collaborative learning in science laboratory experiments has led to an increase in the communication skills scores of the prospective teachers. Teachers, students, and scientists can all benefit from collaboration by providing unique opportunities for each other and meeting some of the challenges that exist in their individual positions (NCR, 1996; Brooks, Dolan and Tax, 2011). At the research onset, the participants graduating from private schools had a higher rate of communication skills on the pre-test compared to the participants graduating from public schools. But when the research was concluded, as shown by the post-test results, the mean communication skills score of the public school graduates was close to that of the private school graduates. This means that communication skills or social skills could be taught and improved in schools using various teaching methods and techniques (Pineteh, 2012; Jackson & Back; 2011, Sergeant, Macleod & Murray; 2011, Manee, Khouiee & Eghbal, 2015; Mccarthy, O'Donovan & Twomey, 2008; Heaven, Cleg & Maguire, 2006; Wilkinson, Perry & Blanchard, 2008). The 21st communication skills have been adopted by Mccarthy, O'Donovan and Twomey (2008) as the bases of interaction. These skills are required in taking up new jobs in the future. In Turkey, many teacher education programs offer effective communication courses; however, using drama, workshops, and exercises would be more beneficial for prospective teachers in their careers. The descriptive analysis following the evaluation of the interview questions revealed certain advantages of inquiry applications over communication skills for prospective teachers, including being respectful, eliminating prejudices, being patient, listening to each other, getting to know each other while maintaining close relationships through telephone, social media, e-mail, etc. All these skills were described as social skills in the studies of Mannberg (2001) and Herlitz (2001) and are related to the Dede's (2009) emphasis on teachers' competences in the 21st century, as well as those of Erozkan (2013), Kramer and Dusmtin (2004), and Kelly, Fenlon and Murphy (2002). One of the main criteria stressed in communication skill development was listening to each other or actively listening to others. The participants in this research explained how they realized the problem and improved listening skills in detail similar to Herlitz (2001). In addition to this, especially in a multicultural society like Turkey, breaking down the prejudices between groups in collaborative works was a very important skill for their professional lives (Mezote, 2011). After training, many students said that they realized changes in their own communication behaviors. Rees, Sheard and Mcpherson (2002) indicated that medicine students, after

training, emphasized the importance of communication skills in being a successful doctor. The participants' difficulties related to communication skills include effective listening, negative communication language, communication with the group members, irrelevant chatting, lack of consciousness about the responsibilities of different roles, effect of dominant personalities during experiment design, joint decision making, task distribution, finishing the tasks on time especially when writing experiment reports, the disregard for receiving high marks, and sharing laboratory materials. The reasons of the difficulties in both communication skills and applications included insufficient knowledge of concepts (Osisioma & Moscovici, 2008; Parim-Aydın & Sahiner, 2014; Leonard, Barnes-Johnson, Dantley and Kimber, 2011), inadequate experience and content knowledge (Mumba, Mejia, Chabalengula & Mbewe, 2010), group work and mandatory attendance, lack of a sense of responsibility, sharing responsibilities, not caring about marks and writing laboratory reports. Writing skills constitute an important component, especially in a teacher's professional life, while most of students have problems in their writing skills as indicated by Gray (2010), Henderson (2001), Albrecht and Sack (2000), Simons and Higgins (1993). Without adequate knowledge of concepts, people usually have communication problems as well, this fact has been observed in the prospective teachers. Scientific inquiry applications, including collaborative work, affect students' communication skills, prepare them for both social life and professional career as they require evaluating claims, investigating ideas, solving problems, drawing valid conclusions, and developing evidence-based arguments (Hackling, Peers & Prain 2007). Prospective teachers should learn to work efficiently within a group, so that they teach students throughout collaborative learning in their lectures especially in science explained in NRC standards (2012, p.63): 'new scientific ideas are acts of imagination, commonly created these days through collaborative efforts of groups of scientists whose critiques and arguments are fundamental to establishing which ideas are worthy of pursuing further'.

Conclusion and Implications

Inquiry-based learning in science laboratories with collaborative work groups could improve the students' communication skills including listening to each other, writing skills, being respectful during discussions, eliminating prejudices, being patient, and getting to know each other. Furthermore, apart from communication skills, their personal skills were developed. What is more, they understood the importance of some personal skills during collaborative works such as meeting the deadlines, taking responsibilities, sharing materials between each other in a group. One of the most important results, in my opinion, was that if the student/individual did not have sufficient content knowledge, information or competence related to work tasks; the problems in communication skills would be unavoidable. In addition to the research results, observation of the students by the researcher also revealed that their abilities improved over time, for example, their writing skills, argumentation abilities, self-regulation, use of native language, and use of technology showed concrete improvement with each laboratory report they handed. Some students created groups on social media to have mutual communicate about reports and presentations. As stated at the end of the research, they got to know each other better. What is more important is their ability to, reduce their prejudices, proving that group work improved people who looked from several perspectives to the solution of problems and brain storming which developed critical thinking abilities. Concerning the way of communication skills acquisition by prospective teachers, we first need to assess the students' communication skills by using both oral and written assessment tools. Secondly, we should plan a program to be integrated into the lectures different from the communication-related ones. The program may include goals such as communication with students, parents, colleagues, directors, and other citizens; being patient; reducing prejudices; responsibility; effective listening; problem solving skills; the ability to express one's ideas and needs. As a third step, we should provide the students with theoretical information about communication skills. In the fourth step, we could provide case studies as examples on how communication skills improve student experiences in a social medium like class, laboratory, garden, or a family meeting. During these activities many techniques can be used such as writing, drama, or video clips. Finally, all documents should be criticized in a class medium, allowing students to evaluate and improve their communication skills.

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