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Prospective Science and Primary School Teachers' Self-efficacy Beliefs in Scientific Literacy

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Abstract

The aim of this study is to determine the self-efficacy beliefs of prospective science and primary school teachers in scientific literacy and to bring out whether it changes depending on some varieties such as department, gender and grade level. The study is applied on 346 students who are educated in a state university's elementary education department. The study group is consisted of the prospective students attending in the first and fourth grades of the science teaching and primary school teaching departments. In this study, "Self-Efficacy Scale in Scientific Literacy" developed by the researchers is used. The reliability coefficient is found as Cronbach α= 0,95. This scale consists of 33 items and is made up of in fivefold form of likert. The findings of this study can be summarized as in the below: Prospective science and primary school teachers' average point of self-efficacy beliefs in scientific literacy is 113,36; namely, it is in the quite enough level. Prospective science and primary school teachers' self-efficacy beliefs in scientific literacy are found meaningfully different according to their department, gender and grade levels.

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Keywords: Scientific literacy, Self-efficacy, Self-efficacy beliefs in scientific literacy, prospective science teacher, prospective primary school teacher

1. Introduction

Although the term "Science and technology literacy" was first came out in 1950s, the interest and concerns towards this term appeared long after. (Laugksch 2000:72). In the schools, especially in last twenty years, it has been an important issue in discussions concerning aims of science education curriculums (Millar 2006: 1499). For

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example; the current intensive interest towards science and technology literacy in America started by the report called "A Nation at Risk" published by "National Commission on Excellence in Education" in 1983. This report brought out that children in America don't get sufficient education especially in science, mathematics and technology. This issue arose the questions such as how science courses are processed in the classrooms and how it should be, how teachers of science education are educated or trained (Parsons, Matson & Quintanar, 2002). Science and technology literacy helps us to be interested in and understand the world that we live in, to question and to be skeptic towards the claims presented by others about scientific issues, to behave based on evidence and to research, to take informative decisions about the environment (Hazen 2002; Hackling, Goodrum & Rennie 2001: 7). One of the important reasons of supporting science and technology literacy is the connection between science and technology literacy and the country's economical welfare level. Because, science and technology literacy will provide more cleverly participation of individuals' to the production sector (Laugksch 2000: 84). The individual with science and technology literacy is the person who is aware of science, math and technology with their advantages and limitations; understands principles and key terms of science; is familiar with natural world and is aware of its diversity and unity; uses scientific methods in his/her personal and social decisions (AAAS 1989). *Science and technology literacy* knows and understanding scientific terms and processes needed for personal decisions, cultural events and economical productivity. Science and technology literacy is to find the answers of the questions came out as result of one's daily experiences and curiosity; and to be able to take a decision. Accordingly, an individual has the ability to define, explain and predict the natural events. Science and technology literacy means one's capacity to be able to define scientific issues, to be able to evaluate the source of scientific knowledge and the methods used to obtain it, to evaluate and use the opinions based on evidence (National Academy of Sciences 1995). *Science and technology literacy* is the ability to behave with the results based on evidence in order to understand natural world and make decisions, to use scientific knowledge, to define the questions (OECD/ PISA 2003: 133). The definitions above give us clues about the features that should be present in the individuals with science and technology literacy as well as the meaning of science and technology literacy. The features that an individual with science and technology literacy has are those (Hurd 1998: 413- 414; Bou Jaoude 2002: 141- 142; Laugksch 2000: 76-78; NSTA 1990; NCREL 2004; AAAS 1989): understands the structure of scientific knowledge; understands and knows scientific terms and scientific operation skills; benefits from findings of science and technology in taking important decisions in daily life and dealing with difficulties encountered; finds the answer of the questions concerning daily experiences and makes decisions; understands the impact of science and technology on daily life and appreciates; has the ability to define, explain and predict natural events; understands the need of synthesis of knowledge from different fields in solving the personal and social problems; understands the necessity of working together in solving the scientific problems concerning the society; evaluates the source of scientific knowledge and the methods used to obtain it; takes into consideration political, economical and ethic aspects of science and technology in personal and universal issues; understands that daily problems (especially the ones that have ethic, legal and politic aspect) related to science may have more than one correct answer; is aware of the fact that global economy can be affected by developments in science and technology; is aware of the advantages and limitations of science and technology; analyses the interactions among science, technology and society; is aware of benefits and responsibilities of scientific and technological developments; knows that almost every aspect of life is affected by science and technology; knows the fact that scientific/technological knowledge may change as long as new evidences are found; distinguishes between reliable and unreliable knowledge, between personal opinion and scientific/technological evidence; can distinguish experts from inexperienced, theory from dogma, data from legend; determines the place of scientific and technological information sources, collects these information, analyses, evaluates and uses these sources in problem solving, taking decisions and taking actions; has a richer, more satisfactory and more interesting worldview as a result of science education and doesn't limit this education to school education, maintains it lifelong. In brief, an individual with science and technology literacy understands the nature of science and scientific knowledge, basic scientific terms, principles, laws and theories and uses them properly; uses scientific process skills while solving problems and taking decisions; understands the interactions among science, technology, society and environment; develops scientific and technical psychomotor skills; shows that he/she has scientific attitude and values. The individuals with science and technology literacy are the ones who are more efficient in attaining and using the knowledge, solving problems, making decisions by taking the potential risks, benefits, alternatives about the problems concerning science and technology into consideration, producing new

knowledge (MONE, 2005: 5). In the present day that passes through information age, the main aim in our education system should be; to make our students have the skills to reach for knowledge rather than transfer them present knowledge. This requires learning by comprehending rather than memorizing, being able to solving the problems concerning new situations encountered and having the skills related to scientific method process. The leading course that these skills are developed is Knowledge of Science (Science and Technology). The course of Knowledge of Science (Science and Technology) is the leading course that provides the child to understand and research the environment, natural events and scientific developments by scientific methods and thinking, to develop problem solving skills during primary education process (Kaptan 1998: 20). From this perspective, science and technology course is important in terms of gaining the individuals science and technology literacy. One of the important factors that affect the students' development of knowledge, skills, attitude, comprehension and values needed for educating individuals with science and technology literacy is the teacher. Therefore, the teacher is required to be a good intellectual and to have reading habits and other skills with a wide point of view (Kaptan & Yetişir 2007). A teacher with science and technology literacy can guide the students in developing themselves who knows when and how to ask question, how to think critically, how to take decisions based on facts and reasons rather than feelings and superstitious beliefs. The teacher can help students to make decisions by considering the potential risks, benefits, alternatives about the problems concerning science and technology while interpreting the knowledge and solving the problems (MONE, 2004).

1.1. Purpose of the study

Science and technology are indispensible parts of our lives. It is of vital importance for students to improve their understanding, skills, attitudes and values towards science and technology in the contemporary age. Students should be encouraged to be citizens working effectively, acting consciously and responsibly in the future by being made to acquire the necessary knowledge, skills, attitudes and values for scientific literacy. The most important people to raise scientifically literate students are primary school teachers who launch the basis of scientific literacy and the ones to continue this education are the science teachers. For this reason, the primary school teachers and the science teachers are expected to be scientifically literate people and have a high perception of self-efficacy in their ability to raise scientifically literate individuals. The aim of this study is to determine the self-efficacy beliefs of prospective science and primary school teachers in scientific literacy and to bring out whether they change depending on some varieties such as department, gender and grade level. In this respect, the study is expected to give feedback to the educational institutions training teachers and provide guidance about the subject of to what extend the activities developing the self-efficacy beliefs in scientific literacy should take place in the curricula.

2. Method

2.1. Study group

The study group of this research has been formed by 346 prospective teachers, 172 of whom are educated at Hacettepe University, Faculty of Education, Division of Science Education and 174 of whom are educated in the Division of Primary Education. 80 freshmen and 92 senior students from the Division of Science Education (172 prospective teachers in total) and 99 freshmen and 75 senior students from the Division of Primary Education (174 prospective teachers in total) have taken place in this study. 72.5% of the study group has consisted of female prospective teachers and 27.5% male prospective teachers. 20.8% of the attendants are graduates of General High Schools, 26.3% of Teacher High Schools/ Anatolian Teacher High Schools, 52.6% of Super High Schools/ Science High Schools/ Anatolian High Schools/ Private High Schools and 0.3% of Vocational High Schools.

2.1. Instrument

In order to determine the self-efficacy beliefs of prospective science and primary school teachers in scientific literacy, "Self-Efficacy Scale in Scientific Literacy" was developed by the researchers. This scale consists of 33

items and is made up of in fivefold form of likert as “highly certain can do, can do, moderately can do, cannot do, cannot do at all”. The initial form of the scale consisting of 50 items was applied on 326 prospective teachers. KMO’s being higher than .60 (.96 > .60) and Barlett test’s being significant have shown that the data obtained via the initial application are suitable for the the factor analysis, in other words; the principal component analysis. It has been observed that according to the principal component analysis, the eigen value of the 33 items gathered under one single factor that is greater than 1. It has been found out that the first factor loads of all 33 items have been .586 and above. This finding demonstrates this scale has a general factor. In addition, the variance caused by the first factor’s being 47,014 % is another evidence of the existence of a general factor. Although three factors were taken into consideration while preparing the scale, the 1st factor load of the items’ being high and the variance’s being high, that it itself explained, demonstrated the scale had a general factor. Hence, the scale has been decided to be used with one factor. The total correlation of the items range from .7464 to .5623 . The final application has been done with a total of 346 prospective teachers, 172 prospective teachers from the Division of Science Education and 174 prospective teachers from the Division of Primary Education. As a result of the final application, the reliability coefficient (Cronbach's alpha) has been calculated and Cronbach's $\alpha = 0.95$ has been found . The lowest score which can be taken from the scale is 33 (33x1 = 33) , while the highest score is 165 (33x5 = 165).

3. Findings

In order to determine whether the total score of prospective science and primary school teachers’self-efficacy beliefs in scientific literacy change depending on their department, independent groups t test was applied. The results of analysis are given in Table 1.

Table 1. The results related to the t-test scores of prospective teachers’ self efficacy beliefs in scientific literacy in regarding their departments

Groups	N	X	S	Sd	t	p
Science Education	172	119,47	18,27			
Primary Education	174	107,32	16,71	344	6,453	0,00
Total	346	113,36	18,51			

p=0,00<0,05

According to the average of the total scores of prospective teachers’ self efficacy beliefs in scientific literacy is 113.36; the average of the items on the scale is 3.44. According to this result, prospective science and primary school teachers find themselves on a "quite sufficient level" in terms of scientific literacy.

As seen in Table 1, the levels of the self-efficacy beliefs of science and primary school teachers vary significantly at the 0.05 level according to their departments. This difference is in favour of the students in the Divison of Science Education. On the basis of this result, it can be said that Science Education students find themselves more enough in scientific literacy. This situation can be explained by the difference between the contents of the curricula applied in the Divisions of Science Education and Primary Education. The number and content of the courses prospective science teachers take differ from those the prospective teachers take. The prospective science teachers mainly take courses related to their field whereas the prostective primary school teachers take courses like Turkish, Social Studies and Maths as well as Science and cannot specialize in a particular area. It can be said that Science teachers' self-efficacy levels have reached a higher level with the effect of this situation. Küçükyılmaz and Duban (2006) intestigated the opinions of the prospective science teachers in relation to the measures that could be taken to increase the elementary teachers ' self -efficacy beliefs in science teaching. The prospective primary school teachers stated the science teaching course had to be completely based on application rather than theory. Kaptan and Yetişir (2007) did a research about the prospective primary school teachers’ opinions about the importance of being a scientifically literate individual. The prospective teachers all stated the significance of scientific literacy, however, none of them considered himself as scientifically literate. Altunçekiç and his friends (2005) , Ören and Tatar (2006), Çakır and Şenler (2007) found out the self-efficacy beliefs of prospective science teachers were higher than the

prospective primary school teachers. These findings support the research results.

In order to determine whether the total score of prospective science and primary school teachers' self-efficacy beliefs in scientific literacy change depending on their gender, independent groups t test was applied. The results of analysis are given in Table 2.

Table 2. The results related to the total t-test scores of prospective teachers' self efficacy beliefs in scientific literacy regarding their gender

Groups	N	X	S	Sd	t	p
Female	251	114,68	17,85			
Male	95	109,86	19,81	344	2,174	0,03
Total	346	113,36	18,51			

p=0,03<0,05

As seen in Table 2, the levels of the self-efficacy beliefs of science and primary school teachers vary significantly at the 0.05 level in relation to their gender. This difference is in favour of the female students. On the basis of this result, it can be said that female students find themselves more enough in scientific literacy.

In order to determine whether the total score of prospective science and primary school teachers' self-efficacy beliefs in scientific literacy change regarding on their grades, independent groups t test was applied. The results of analysis are given in Table 3.

Table 3. The results related to the total t-test scores of prospective teachers' self efficacy beliefs in scientific literacy regarding their grades

Groups	N	χ	S	Sd	T	p
1st Grade (Freshmen)	179	108,88	18,02			
4th Grade (Senior)	167	118,16	17,86	344	4,806	,00
Total	346	113,36	18,51			

p= 0,00< 0,05

As seen in Table 3, the levels of the self-efficacy beliefs of science and primary school teachers vary significantly at the 0.05 level in relation to their gender. This difference is in favour of the 4th grade (senior) students. On the basis of this result, it can be said that 4th grade (senior) students find themselves more enough in scientific literacy. Analyzing Table 3 and class science and technology teachers' science and technology literacy self -efficacy according to the class was found significantly different at the 0.05 level. This difference is in favor of 4th grade. Based on these findings, 4th grade students, science and technology literacy said they see themselves in a more adequate. This situation can be explained by their adaptation to their division, the experiences they gain through their education and their education until the 4th grade itself. Moreover, when the courses taken from the 1st grade until the 4th grade are examined, it is seen that the difference is also caused by these courses. Since the prospective teachers mainly take major area courses (physics, chemistry, biology, mathematics, Turkish, geography), they do not have enough knowledge of scientific literacy. However, they take science education courses in higher grades. So knowing about scientific literacy may have contributed to their self-efficacy beliefs.

4. Conclusion

The average of the total scores of prospective teachers' self efficacy beliefs in scientific literacy is 113.36; the average of the items on the scale is 3.44. According to this result , prospective science and primary school teachers find themselves on a "quite sufficient level" in terms of scientific literacy. The average of the total scores of the prospective teachers educated in the Division of Science Education taken from the scale is 119.47. On the other hand, the average of the total scores of the prospective teachers educated in the Division of Primary Education taken

from the scale is 107.32. The self-efficacy beliefs of science and primary school teachers vary significantly at the 0.05 level regarding their departments. According to this result, prospective science teachers see themselves more sufficient when compared to the prospective primary school teachers. The average of the total test scores of female prospective teachers is 114.68 and The average of the total test scores of male prospective teachers is 109.86. When both are evaluated together, a significant difference in favour of the female students has been obtained. Nonetheless, when divisions are handled separately, there is not a significant difference regarding gender. The average of the total scores of 1st grade prospective science and primary school teachers is 108.88 and the 4th grade prospective teachers' is 118.16. The levels of the self-efficacy beliefs of science and primary school teachers vary significantly at the 0.05 level in relation to their grade. This difference is in favour of the 4th grade (senior) students. When these prospective teachers are evaluated separately regarding their grades, it has been found that the self-efficacy beliefs of the prospective teachers educated in the Division of Science Education do not depend on their grades; but the self-efficacy beliefs of the prospective teachers educated in the Division of Primary Education do depend on their grades. At the end of the study, prospective science and primary school teachers' self-efficacy beliefs in scientific literacy are found meaningfully different according to their department, gender and grade levels. Relying on the findings of the study, the following suggestions can be made: There should be more emphasis on science education in the Division of Primary Education. Besides, in the institutions educating teachers, it will be useful to include practices to increase the self-efficacy beliefs of prospective teachers. If we think that direct experiences have great influence of self-efficacy beliefs, prospective students should be given more chance to practice. In addition, the education they get should support this situation. For example, "School Experience" course in Education Faculties should be given more time. In this way, prospective teachers should have much more number of lessons in the schools where they undergo training and become more experienced. If this is done, the self-efficacy beliefs of prospective teachers get stronger.

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