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# Determining the levels of pre-service science teachers' scientific literacy and investigating effectuality of the education faculties about developing scientific literacy

Sema Altun-Yalçın [a]*, Sibel Açışlı [a], Ümit Turgut [b]

[a] *The Faculty of Education, Erzincan University, 24000 Erzincan, Turkey*
[b] *The Faculty of Education, Atatürk University, 25000 Erzurum, Turkey*

**Abstract**

The term "scientific literacy" has become a dominant educational slogan and a major goal for science education in many countries over the past two decades. Although a scientifically literate society is an ultimate goal of science education in Turkey, as well as in other countries, there is not much information on scientific literacy levels even for people who deal with science first-hand. Whether people who deal with science, such as scientists and science teachers, have adequate levels of scientific literacy is still open to investigation.

This study aimed to examine scientific literacy levels of pre-service science teachers at different grade levels (different class, eg., first year Science Teacher Training Departments' students). One of the aims of this study is investigating effectuality of the education faculties about developing scientific literacy. The study examined whether there is a statistically meaningful difference among science literacy levels of pre-service science teachers at different grade levels. The data obtained from the study contributed to determine at what levels scientific literacy of pre-service teachers were. Furthermore, it provided to be observed how the education in the Faculty of Education had affected scientific literacy levels of pre-service teachers as well. So, it is thought to make contribution to understanding how Education Faculties could perform the mission for which they are responsible in providing these students as teachers of the future with scientific literacy being one of the features a good teacher needs to have.


*Keywords:* scientific literacy, gender differance, preservice science teachers, education faculty mission, grade level, academical level

## 1. Introduction

Scientific literacy is defined here as knowing basic facts and concepts about science and having an understanding of how science works. It is important to have some knowledge of basic scientific facts, concepts, and vocabulary. Those who possess such knowledge are better able to follow science news reports and participate in public discourse on science-related issues. An appreciation of the scientific process may be even more important. Understanding how ideas are investigated and analyzed is a sure sign of scientific literacy. It is valuable not only in keeping up with important science-related issues, but also in evaluating and assessing the validity of any type of information and participating meaningfully in the political process. (Maienschein 1999).

* Sema Altun Yalçin
*E-mail address*: saltun_11@hotmail.com

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The term "scientific literacy" has become a dominant educational slogan and a major goal for science education in many countries over the past two decades (Millar, 2006). A scientifically literate society is an ultimate goal of science education in Turkey, as well as in other countries, there is not much information on scientific literacy levels, even for people who deal with science first-hand. Whether people dealing with science, such as scientists and science teachers, have adequate levels of scientific literacy is still open to investigation (Ozdem 2009).

Science educators and researchers have defined scientific literacy in at least seven dimensions (Rubba & Anderson, 1978).
The scientific-literate person:
- understands the nature of scientific knowledge;
- accurately applies appropriate science concepts, principles, laws and the theories in interacting with his/her universe;
- uses processes of science in solving problems; making decisions and furthering his/her own understanding of the universe;
- interacts with the various aspects of his/her universe in a way that is consistent with values that underlie science;
- understands and appreciates the joint enterprises of science and technology and the interrelationships of these with each other and with other aspects of society;
- has developed a richer, more satisfying and more exciting view of the universe as a result of his/her science education and continues to extend this education throughout his/her life;
- has developed numerous manipulative skills associated with science technology.

Teachers are the most important factor in promoting scientific literacy. Therefore, they must be well prepared in science subjects. In addition, they must have a firm understanding of science and be abreast of the current technological advances affecting society every day. Teachers' role is crucial in promoting science literacy in schools and society. Research on teachers' knowledge suggests that both teachers' subject matter knowledge and teachers' pedagogical knowledge are crucial to good science teaching and student understanding (Shulman, 1987).

Therefore, the purpose of this study is to investigate the scientific literacy levels of students who are the nominees of future society as science teachers. The research questions that guided this study are:

1. What are the scientific literacy levels of pre-service science teachers at different levels?
2. What is the effect of education given in Education Faculties on the science literacy levels of pre-service science teachers?
3. Is there a meaningful difference among science literacy levels of pre-service science teachers at different academic level?

**Methodology**

The study consists of students at different grades enrolled in science education at Bayburt University, Faculty of Education in the 2008-2009 academic years. The sample unit was formed by 230 students in total, 80 first grade students, 75 second grade students, 35 third grade students, 40 fourth grade students. Data were collected through likert-type scale in the study. The scale (developed by Derman, Doğu and Gödek Altuk (1989)) to assess level of pre-service teachers about the science and technology literacy was used in this study to assess levels of scientific literacy. The scale included 16 questions. The students' answers are graded as yes-3, partly-2 and no-1. The data obtained at the end of the study were analyzed by the way of a packet programme.

## 2. Results

The purpose of this study is to investigate how science teacher training programs provided by education faculties affect teacher candidates' scientific literacy levels according to their gender and grade (academic) level. In order to determine whether gender or grade level affected the results, data were analyzed using a two-way analysis of variance. The assumption of homogeneity of variance was tested using the Levene test. Levene test results are

shown in Table 1. Levene's test result value p = 0,000< 0.05 showed not the homogeneity of the variances between groups. Case is not considered to be homogeneous variances, Tamhane's $T^2$ test result used in the interpretations (Kalaycı, 2008).

Table 1. The results of Levene's test for equality of variances

| Dependent variable | F | df1 | df2 | Sig. |
|---|---|---|---|---|
| Scientific literacy | 5.675 | 7 | 222 | .000 |

The results of Table 2 indicate that the mean score of the first year students' scientific literacy is 39.15; the mean score of the second year students' scientific literacy is 39.72; the mean score of third-year students and fourth-year students is 39.92, and 41.69, respectively. According to these findings, it can be concluded that pre-service science teachers' scientific literacy level is very high.

Table 2. Students' standard deviation and mean of scientific literacy according to grade level and gender

| Grade level | Gender | Number of participants | Mean | Standard deviation |
|---|---|---|---|---|
| 1. grade | Female | 29 | 39.51 | 4.54 |
| | Male | 51 | 39.11 | 3.39 |
| | Total | 80 | 39.26 | 3.82 |
| 2. grade | Female | 35 | 40.05 | 2.67 |
| | Male | 40 | 39.45 | 3.75 |
| | Total | 75 | 39.73 | 3.28 |
| 3. grade | Female | 11 | 40.36 | 1.68 |
| | Male | 24 | 40.66 | 1.73 |
| | Total | 35 | 40.57 | 1.70 |
| 4. grade | female | 11 | 40.23 | 3.38 |
| | male | 29 | 39.98 | 3.65 |
| | total | 40 | 40.07 | 3.55 |

In Table 3, p values indicate that there is no statistically significant difference between female and male mean scores regarding their scientific literacy (p =. 457> .05). It was concluded that there is no gender difference in students' scientific literacy. In addition, mean scores according to the grade level and scientific literacy showed a significant relationship between these two variables (p =. 002< .05). In other words, students' grade levels had an effect on their scientific level. In addition, the joint effects of gender and grade level on students' scientific literacy scores is not statistically significant (p =. 917 >.05). The results clarified that a statistically significant relationship does not exist between these two factors (gender and grade level) and a dependent variable. Thus, there is a need for applying to post-hoc Scheffé test.

Table 3. As a result of a two-way ANOVA with factors of gender and grade level

| Source | Sum of squares | df | Mean square | F | P | Eta squared |
|---|---|---|---|---|---|---|
| gender | 6.652 | 1 | 6.652 | .554 | .457 | .002 |
| grade | 189.075 | 3 | 63.025 | 5.254 | .002 | .066 |
| gender*grade | 6.095 | 3 | 2.032 | .169 | .917 | .002 |

According to the results of multiple comparisons between pores, the mean score of male students' scientific literacy is 40.231 and the mean score of female students' scientific literacy is 40.621. From Table 4, the female and male students' scientific literacy score mean difference is .390, standard error is .524. In addition, there is no statistically meaningful difference between male and female students' scientific literacy scores (p.457>.05).

Table 5 demonstrates that science department first, second, third and fourth grade students' scientific literacy scores compared with each other whether there is a statistically significant difference between each other or not. Table 5 indicates that there is a statistically meaningful difference between the mean scores of first year students' scientific literacy and the mean scores of fourth year students' scientific literacy ($p=.005<.05$). In the addition to this, Table 2 shows that mean scores of students' scientific literacy increase proportionally with grade of degree. This conclusion supports the results obtained from Table 5.

Table 5. Grade level factors' multi-factor comparison

| Grade level(I) | Grade level (J) | (I-J)Mean difference | Standard error | p |
|---|---|---|---|---|
| 1 | 2 | -.470 | .556 | .959 |
| | 3 | -1.30 | .701 | .073 |
| | 4 | -2.66 | .670 | .005 |
| 2 | 1 | .470 | .556 | .959 |
| | 3 | -.838 | .709 | .400 |
| | 4 | -2.191 | .678 | .024 |
| 3 | 1 | 1.30 | .701 | .073 |
| | 2 | .838 | .709 | .400 |
| | 4 | -1.353 | .801 | .294 |
| 4 | 1 | 2.66 | .670 | .005 |
| | 2 | 2.191 | .678 | .024 |
| | 3 | 1.353 | .801 | .294 |

## 3. Discussion

This study investigated how science teacher training programs provided by education faculties affect teacher candidates' scientific literacy levels and which level teacher candidates' scientific literacy is. It says that instruction in education faculty provide positive changing students' scientific literacy scores in order of grade level. In other words, instructions in education faculty develop students' scientific literacy levels. In addition to this, it can be concluded that different grade level undergraduate students' scientific literacy levels are very high. There is no statistically meaningful difference between female and male students' scientific literacy levels. In short, students' gender has no affect on scientific literacy levels. The results imply that the grade level and program are effective to determine the scientific literacy levels, whereas gender is not determinative.

In Turkey, integration of scientific and technological literacy is the main goal of science education. Scientific literacy is required to search and question, think critically, develop problem-solving and decision making abilities, be life-long learners, pursue the interest in their environment and the earth, and their combination of attitudes towards, values about, understanding of and knowledge about science. And the teacher is the most important individual in the education of society and in ensuring the scientific literacy of students. Science teacher students' scientific literacy levels may be enhanced through training they have received. Contemporary approaches to education that allow students in schools to be intertwined with science are applied (Altun et al. 2007; Altun 2008). The use of modern educational approaches in education can be achieved these students' better understanding of science, the development of attitudes toward science and increase self-sufficiency about science.

## Conclusion

More work should be done by using different questionnaires and methods and different students and people (preservice teachers, inservice teachers). So that study data's errors arising from the scale will be adjusted. If use different sample, this study data can be generalized. And future study about student and teachers' scientific literacy level must focus on how increasing scientific literacy level.

## References

Altun, S., Turgut, Ü. ve Büyükkasap, E. (2007). Proje Tabanlı Öğrenme Yaklaşımının Fen Bilgisi Öğretmen Adaylarının Hareket ve Kuvvet Konusundaki Akademik Başarılarına ve Tutumlarına Etkisi. Ulusal Teknik Eğitim, Mühendislik ve Eğitim Bilimleri Genç Araştırmacılar Sempozyumu, 20-22 Haziran 2007, Kocaeli

Altun, S. (2008). The Effect of Project Based Learning on The Science Undergraduates' Belief of Self –Efficacy Towards Physics. XIII. IOSTE Symposium, September 21-26, 2008, Turkey.

Derman, A., Doğu, S. ve Gödek-Altuk, Y. (2008). The primary scholl teachers' beliefs about science and techonogy literacy level. 8th International Educational Techonology Conference (IETC 2008) Proceedings Eskişehir, Turkey, 6-9 May 2008.

Maienschein, J. 1999. Commentary: To the future argument for scientific literacy. *Science Communication*, 21(1):75-87

Millar, R. (2006). Twenty first century science: Insights from the design and implementation of a scientific literacy approach in school science. International Journal of Science Education, 28, 1499-1521.

Ozdem, Y., Ertepinar, H., Cavas, B. Pınar Cavas(2009).The Turkish Science and Science Education Students' Scientific Literacy Level. The European Conference on Educational Research. 28 - 30 September 2009 Vienna, Austria.

Rubba, P. A. & Anderson, H. O. (1978) Development of an instrument to assess secondary school students' understanding of the nature of scientific knowledge, Science Education, 62, 449–458.

Rubba, P. A., & Anderson, H. O. (1978). Development of an instrument to assess secondary school students' understanding of the nature of scientific knowledge. Science Education, 62(4), 449–458.

Shulman, L. S. (1987). Knowledge and Teaching: Foundations of the new reform. Harvard Educational Review, 57(1), 1-22.

Kalaycı, Ş. (2008). SPSS Uygulamalı Çok Değişkenli İstatistik Teknikleri. Asil Yayın Dağıtım, ANKARA.