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How are prospective science teachers' values and their attitudes toward science associated?: Implications for science teacher training programs

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Abstract

This study aimed to examine the associations between prospective science teachers' values (theoretical, religious, economic, aesthetic, social and political values) and their attitudes towards science teaching. Cross-sectional research design was used. The adapted versions of Science Teaching Attitudes Scale (STAS-II) and Allport Vernon Lindzey Values Tests (SOV) were applied to 337 prospective science teachers. STAS-II and SOV were used for assessing prospective science teachers' attitudes toward science teaching and their values respectively. As a result of list-wise deletion, the sample appeared to include 281 prospective science teachers. The data were examined with correlation and stepwise multiple regression analysis. The correlation analysis showed that prospective science teachers' political, social, economic and aesthetic values were not significantly correlated with their attitudes toward science teaching at $p < .01$ level. On the other hand, prospective science teachers' theoretical values were positively associated with their attitudes toward science teaching ($r = 0.155$, $p < .01$). Moreover, prospective science teachers' religious values were negatively correlated with their attitudes toward science teaching ($r = -0.224$, $p < .01$). Multiple regression analysis also indicated that religious values of prospective science teachers were significant predictors of their attitudes toward science teaching ($F(2, 280) = 14.787$, $p < .01$). It can be concluded that there is a weak positive association between prospective science teachers' theoretical values and their attitudes toward science teaching. However, regression analysis reveals that theoretical value is not a significant predictor of attitudes toward science teaching. As for significant predictors of prospective science teachers, it is found that religious values of prospective science teachers are significant predictors, which may negatively affect prospective science teachers' attitudes toward science teaching. So, it is suggested that science teachers must be aware that religion and science are two different ways of knowing. In this respect, the present study emphasizes the importance of explicitly discussing the different ways of knowing in science teacher training programs in order to neutralize the possible negative impacts of religious values of science teachers on their attitudes toward science teaching.

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Keywords: Attitudes toward science teaching; values; prospective science teachers

1. Introduction

Developing scientific literacy is one of the aims of science education (Ministry of Education of Turkey [MEB], 2005; National Research Council [NRC], 1996; National Science Teacher Association [NSTA], 1982). Although there is no single definition of scientific literacy, it involves "...an understanding of (1) the nature and limitations of science, (2) the basic concepts and principles (laws and theories) of science, (3) the technological applications of science, (4) the value of science as a contributor to the decision making process of the major societal issues of our time, and (5) the uses of scientific knowledge in public policy decisions" (Adams, 1990). Having these various dimensions, it is not an easy task to create a scientifically literate society, for which science teachers' positive attitudes toward science teaching have a crucial role.

According to the theory of reasoned action, 'attitudes follow reasonably from the beliefs people hold about the object of attitude' (Ajzen and Fishbein, 1975, 1980 in Ajzen, 1988, p.32). Consistently with this theory, it is argued that teachers' beliefs greatly influence their attitudes (Atwater, Gardner and Kight, 1991). Allchin (1999) also states that 'science teachers who

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understand the multi-faceted relationship between science and values can guide students more effectively in fully appreciating the nature of science', which is a crucial dimension of scientific literacy (p.1). Values, on the other hand, are defined as abstract ideas, positive or negative, that represent beliefs about ideal modes of conduct and ideal terminal goals (Rokeach, 1968, in Gari, Mylonas, and Karagianni, 2005). It is a misconception that science is independent of sociocultural environment in general and values in particular Allchin (1998).

In a study with 1040 preservice elementary science teachers, Cobern et al. (2006) assessed students' valuation of science *vis a vis* culturally important categories such as epistemology, economy, religion, aesthetics etc. As a result of this study, Cobern et al. (2006) concluded that 'science interest might be improved by more contextual teaching approaches that seek to develop the valuation of science within a cultural context' (p.1303). In another study, Sinclair et al. (1997) aimed to assess college students' understanding and acceptance of scientific evidence supporting evolutionary theory. They found that most students did not understand the primary tenets of evolutionary biology while some of them felt that 'evolutionary theory and their religious beliefs were at odds' (p.167).

In their study of values, Allport, Vernon & Lindzey (1960b) attempted to measure the relative prominence value types. They (1960a) suggested that each person consists of a value combination of six value types, which include "Theoretical", "Economic", "Aesthetic", "Social", "Political" and "Religious" values. Theoretical value refers to the interest in discovery of truth. Economic value is related to practical matters and usefulness. Aesthetic value refers to the interest in form and harmony. Social value refers to the altruistic and philanthropic aspect of love of people. Political value is related to the interest in power and religious value refers to comprehending universe in its unity (Allport et al., 1960).

Within this framework, the present study hypothesizes that prospective science teachers' values including "Theoretical", "Economic", "Aesthetic", "Social", "Political" and "Religious" values are associated with their attitudes toward science teaching. Moreover, science teachers' attitudes toward science teaching refer to hypothetical constructs that represent science teachers' like or dislike for science teaching. In this respect, science teachers can hold positive, negative or neutral attitudes towards science teaching. The present study aims to examine the associations between prospective science teachers' values and their attitudes toward science teaching so as to be able to find out the significant predictors of prospective science teachers' attitudes towards science teaching.

2. Method

2.1. Research Design and Sample:

Cross-sectional research design was used. Data were collected from 337 prospective science teachers in two state universities in Turkey. As a result of list-wise deletion, the sample appeared to include 281 students (Table 1).

Table 1. Sample Characteristics

	4 th year		3 rd year		Total
	Male	Female	Male	Female	
University A	43	54	47	49	193
University B	15	23	15	35	88

2.2. Instruments

The adapted versions of Science Teaching Attitudes Scale (STAS-II) and Allport Vernon Lindzey Values Tests (SOV) were used for assessing prospective science teachers' attitudes toward science teaching and their values respectively.

a) STAS-II: The test consists of 60 likert-type statements related to science and teaching science. The statements include 30 positive and 30 negative statements toward science and science teaching and are assigned to 8 sub-scales. This test was widely used in international researches and translated into several languages including Thai, Hebrew and Spanish (Moore et al., 1997). Turkmen (1999) adapted this test into Turkish. The reliability of this Turkish form of the test was found to be 0.80 with the test-retest method (Turkmen et al, 1999). Three of the subscales measure the attitudes toward science teaching with 30 items. These subscales consist of items related to positive and negative attitudes toward teaching science, teaching processes or facts in science class and role of teacher as facilitator or transferring knowledge. The sum of the scores of these three dimensions represents teachers' attitudes toward science teaching.

b) SOV: In their study of values test Allport, Vernon and Lindzey (1960b) attempted to measure the relative prominence value types. They (1960a) suggested that each person consists of a value combination of six value types, which include 'Theoretical', 'Economic', 'Aesthetic', 'Social', 'Political' and 'Religious' values. Around these six basic value types the instrument uses a 'forced-choice method'. That is to say, given two or more alternatives the individual is forced to select preferences by assigning scores to them. Then, these scores are totalled according to the instructions and final score points out the relative importance of the six values in the individual's life. This test was cited in numerous studies in various fields including psychology, medicine, education etc. (Silberman, 1976, Gari et al., 2005). The reliability of the test computed by Cronbach Alpha estimates was found to be 0.90. This test was also adapted into Turkish and previous researchers used this adapted version (Ardac et al., 1994).

2.3. Findings:

The data were examined with correlation and stepwise multiple regression analysis. The results of correlation analysis are seen in Table 2.

Table 2. Correlations

		Theoretical Value	Economic Value	Aesthetic Value	Social Value	Political Value	Religious Value
Attitudes Toward Science Education	Pearson Correlation	.155*	-.061	.145	.101	.062	-.224*
	Sig. (2-tailed)	.009	.309	.015	.092	.301	.000
	N	281	281	281	281	281	281

*. Correlation is significant at the 0.01 level

The correlation analysis showed that prospective science teachers' political, social, economic and aesthetic values were not significantly correlated with their attitudes toward science teaching at $p < .01$ level. On the other hand, prospective science teachers' theoretical values were positively associated with their attitudes toward science teaching ($r = 0.155$, $p < .01$). Moreover, prospective science teachers' religious values were negatively correlated with their attitudes toward science teaching ($r = -0.224$, $p < .01$).

In addition, the following regression equation was tested in order to specify the significant predictors of prospective science teachers' attitudes toward science teaching.

Attitudes toward science teaching = constant + a (theoretical values) + b (economic values) + c (aesthetic values) + d (social values) + e (political values) + f (religious values)

The results of stepwise regression analysis is seen in Table 3.

Table 3. Regression Coefficients

Variables	B	Standart error β	Standardized β	T	p
Constant	104.69	5.12		56.687	0.00
Religious Value	-0.16	0.09	-0.224	-3.845	0.00

R = 0.224 R² = 0.05
F = 14.787 p < 0.01

According to the results of multiple regression analysis (table 3), the final linear equation was found to be as follows:
Attitudes Toward Science Teaching = 104.69 - 0.16 (Religious Value)

As a result, this equation implies that religious values of prospective science teachers were significant predictors of their attitudes toward science teaching ($F(1, 280) = 14.787$, $p < .01$).

3. Conclusion and implications:

It can be concluded that there is a weak positive association between prospective science teachers' theoretical values and their attitudes toward science teaching. However, regression analysis reveals that theoretical value is not a significant predictor of attitudes toward science teaching. As for significant predictors of prospective science teachers, it is found that religious values of prospective science teachers are significant predictors, which may negatively affect prospective science teachers' attitudes toward science teaching.

By quantifying the negative influence of prospective science teachers' religious values on their attitudes toward science teaching, the present study emphasizes the importance of explicitly discussing the different ways of knowing in science teacher training programs in order to neutralize the possible negative impacts of religious values of science teachers on their attitudes toward science teaching. Ensuring coexistence of science and religion as two distinct ways of knowing can help science teachers teach effectively so as to have scientifically literate students. On the one hand, science asks questions about the physical world around us and comes to conclusions through observation, experiment and reasoning. On the other hand, religion asks questions about supernatural world and comes to conclusions through revelation, practice, and faith. In this sense, science and religion ask different questions and use different methodologies to make sense of the physical and supernatural world, and therefore, they are not opposing ways of knowing (Zimmerman, 2006).

Not fully appreciating these distinctions between religion and science may result in interference of personal religious values of science teachers on their attitudes toward science teaching. So, it is suggested that science teachers must be aware that religion and science are two different ways of knowing, and therefore, their attitudes toward science teaching and science practices in classes have to be unrelated to their religious beliefs.

Brickhouse, Dagher, Letts and Shipman (2000) recommended inclusion of treatment of science and religion in college-level science courses so as to prevent comparison of scientific explanations and religious views. They also state that ‘this should not be treated as an unqualified recommendation, for the religious beliefs of some instructors or their institutional settings might well preclude an effective intervention’ (p.354). Thus, it might be crucial to discuss the incommensurable nature of scientific and religious discourse in science teacher training programmes.

Yet, the findings of this study need to be supported by further studies, as this analysis is limited with the instruments used and the prospective science teachers in Turkey. This implies that participants have similar cultural backgrounds and religious beliefs that mostly include Islam. For this reason, the model needs to be verified with further samples including science teachers from different cultural and religious backgrounds.

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