



IN-SERVICE ELEMENTARY SCHOOL TEACHERS' BELIEFS IN SCIENCE TEACHING PRACTICES

İLKÖĞRETİM OKULU ÖĞRETMENLERİNİN FEN ÖĞRETİMİNE YÖNELİK İNANÇLARI

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ABSTRACT: The present study aimed to (1) determine elementary school teachers' beliefs in using reform-based instructional strategies and traditional teaching approaches in science classrooms as well as their self-efficacy beliefs in science teaching, (2) examine the effect of sex and school type on those beliefs, and (3) investigate the significant predictors of teachers' beliefs in using inquiry-based teaching strategies. The data were collected through implementation of Turkish version of 'Teacher Beliefs toward Instructional Pedagogies Questionnaire' to 197 in-service teachers. The results reflected that the participants had strong favorable beliefs in using inquiry-based and technology-enhanced instructional strategies, whereas they did not hold strong beliefs to use traditionally-designed instructional strategies. The results also revealed that private school teachers had significantly higher self-efficacy beliefs than public school teachers. It was found that beliefs in using technology, self-efficacy, and experience in teaching were among the significant predictors of beliefs in using inquiry-based instructional strategies.

Keywords: in-service teachers, beliefs, inquiry, technology

ÖZET: Bu çalışmanın amacı (1) ilköğretim okullarında çalışan öğretmenlerin fen öğretiminde reforma dayalı öğretim stratejileri ile geleneksel öğretim yöntemlerinin kullanımına yönelik inançlarını ve fen öğretimine yönelik öz-yeterlik algılarını belirlemek, (2) bu inançlara çalışmakta oldukları okul tipinin ve cinsiyetin etkisini incelemek ve (3) öğretmenlerin sorgulamaya dayalı öğretim stratejilerinin kullanımına yönelik inançlarının anlamlı belirleyicilerini tespit etmektir. Veriler, 'Öğretim Pedagojilerine Yönelik Öğretmen İnançları Ölçeği'nin Türkçeye adaptasyonun 197 öğretmene uygulanmasıyla elde edilmiştir. Sonuçlara göre katılımcılar sorgulamaya ve teknoloji kullanımına dayalı öğretim stratejilerine yönelik güçlü inançlara sahipken geleneksel öğretim yöntemlerinin kullanımına yönelik kısmen daha zayıf inançlara sahiptirler. Sonuçlar aynı zamanda özel okullarda çalışan öğretmenlerin devlet okullarında çalışan öğretmenlere göre daha yüksek öz-yeterlik algısına sahip olduklarını göstermiştir. Teknoloji kullanımına yönelik inanç, öz-yeterlik algısı ve öğretmenlik tecrübesinin sorgulamaya dayalı öğretim stratejilerinin kullanımına yönelik inançları açıklamada anlamlı belirleyiciler arasında yer aldıkları bulunmuştur.

Anahtar sözcükler: öğretmenler, inançlar, sorgulama, teknoloji

1. INTRODUCTION

Educational reformers have advocated that all students are capable of learning science when appropriate learning opportunities accompanied by effective instructional strategies are provided (Beck, Czerniak, & Lumpe, 2000). However, it was reported that traditionally designed instruction let students memorize facts in textbooks and verify known phenomena through performing some experiments rather than meaningful learning (College Entrance Examination Board [CEEB], 1990). Furthermore, the students have been in a failure to connect the content of courses to real life applications, and to develop the necessary skills to identify and solve problems generated from real life situations by traditionally designed science instruction (Seymour & Hewitt, 1997). Thus, the major trend in educational reform has shifted from traditionally designed instruction to hands-on tasks that promote active engagement through inquiry (The American Association for the Advancement of Science [AAAS], 1993; National Research Council [NRC], 1996).

In recent years, inquiry based instructional practices has played a central role for science learning as portrayed in the National Science Education Standards (NRC, 1996). Inquiry-based experiences involve useful questions, plan and conduct some investigations, use suitable tools and

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techniques to collect data, construct and analyze alternative explanations, and communicate on findings (Johnson, 2006). In construction process of students' meaningful learning through inquiry, some researchers (Owens, Hester & Teale, 2002) suggested using technology as a facilitator for that process. Owens, Hester and Teale (2002) advocated that technology can stimulate students' curiosity, and facilitate learning by providing a real world context that engages learners in solving complex problems. Supporting these ideas, Leu (2001) pointed out that students could prepare creative presentations integrating visual images and sounds into texts which allow them to share their own interpretations based on their inquiry.

There are some research studies which imply that reform-oriented instructional strategies lead more effective learning experiences (Kirschner, Sweller, & Clark, 2006). However, it is a doubt whether teachers implement inquiry-based practices in science learning environments. Some researchers (Marshall, Horton, Igo & Switzer, 2009) have pointed out that teachers may avoid using inquiry-based instructional strategies due to some factors. For instance, the complex nature of inquiry-based instructional practices, particularly monitoring students to handle various tasks, gathering and applying information to solve real life problems may act as a barrier in implementation of these instructional strategies (Puntambekar, Stylianou & Golstein, 2007). Furthermore, teachers' may not be willing to use inquiry-based instructional strategies on account of a lack of experience with non-traditional instructional practices (Borko & Putman, 1996). In fact, to engage students in scientific inquiry, teachers should believe that inquiry-based teaching will facilitate students' meaningful learning. In addition, teachers should be confident in their ability to use inquiry-based instructional strategies (Damjanovic, 1999). Some researchers pointed out that many teachers could not develop a sound understanding of inquiry-based approach or do not have strong self-efficacy beliefs to involve their students into inquiry process (Schauble, Klopfer, & Raghavan, 1991; White & Frederiksen, 1998). Thus, teachers' beliefs could be accepted as one of the important factors to restrict the implementation of reform-based curriculum connected to instructional practices. Teachers with traditional beliefs show little change in their classroom practices and low levels of implementation of the curriculum (Roehrig & Kruse, 2005).

In light of the literature review, since teachers possess beliefs regarding professional practice and these beliefs may impact their actions in classroom, examining teachers' beliefs in teaching practices would make a great contribution to meet the requirements of educational reform efforts. Reform movements on science education in Turkey have some common aims with the National Science Education Standards (NRC, 1996) where students will be given opportunities for engaging in thinking processes through inquiry, including problem solving, critical thinking, communication, and reasoning (Ministry of National Education [MNE], 2005). Additionally, the curricular reform in Turkey gives particular importance to the basic requirements of children's knowledge, learning, emotions, skills, attitudes, interests, and social skills. That is, in light with new curriculum movement more emphasis is directed to the students' cognitive, affective, and psychological developmental processes through inquiry (MNE, 2005). From this point of view, it becomes crucially important to investigate teachers' beliefs in using these reform-based instructional strategies and the potential factors which effect these beliefs.

In this aspect, the following questions guided the present study:

1. What are elementary school teachers' beliefs in using inquiry-based learning environments, traditional teaching approaches and technology in their science classrooms as well as their self-efficacy beliefs in science teaching?
2. What is the effect of sex and school type on elementary school teachers' beliefs in science teaching practices?
3. How well can elementary school teachers' beliefs in using inquiry-based teaching strategies be predicted from beliefs in using traditional teaching approaches, beliefs in using technology, experience and self-efficacy beliefs in teaching science?

2. METHOD

2.1. Participants

A total of 197 randomly selected in-service elementary school teachers participated in this study. More specifically, 54 (27.4%) elementary science and 143 (72.6%) K-5 classroom teachers working at public (N=133 (67.5%)) and private (N=64 (32.5%)) elementary schools in Ankara, Turkey constituted the sample of the study. The data was collected during 2006-2007 academic year where 72 (36.5%) of the teachers were teaching from K-1 to K-3 grade levels, 72 (36.5%) of them were teaching from K-4 to K-5, and 53 (27.0%) of them were teaching K-6 to K-8 grade levels. More than half of the participants had a teaching experience of less than or equal to 10 years. In addition, most of the participants were females. Detailed information related to demographics of the participants is presented in Table 1.

Table 1: In-service Elementary School Teachers' Demographic Characteristics

		Subject Area		
		Science (N=54)	Classroom (N=143)	Total (N=197)
Gender	Female	40	107	147 (74.6%)
	Male	14	36	50 (25.4%)
School Type	Public	30	103	133 (67.5%)
	Private	24	40	64 (32.5%)
Grade Level (K)	1-3	3	69	72 (36.5%)
	4-5	4	68	72 (36.5%)
	6-8	47	6	53 (27.0%)
Teaching Experience	1-5	18	34	52 (26.4%)
	6-10	11	40	51 (25.9%)
	11-16	10	16	26 (13.2%)
	16-more	15	53	68 (34.5%)

2.2. Instrument

In the present study, the data was collected through the implementation of the Turkish version of "Teacher Beliefs toward Instructional Pedagogies Questionnaire (TBIPQ)" developed by Race (2001). The questionnaire consisted of 31 items, divided into four sections, namely, beliefs in using inquiry-based (10 items), traditionally based (7 items), and technology-enhanced (8 items) instructional strategies, and self-efficacy beliefs in teaching science (6 items). These items were rated on a 5-point Likert-type scale ranging from 1= strongly disagree to 5=strongly agree.

For the present study, the TBIPQ was carefully translated and adapted into Turkish with regard to social, cultural, and educational settings of in-service elementary science and classroom teachers in Turkey. Furthermore, some of the content specific expressions were simplified based on the language variety in different curricular contents. For content validity concerns, the adapted version of the questionnaire was examined by two professors from the department of elementary education. The questionnaire was revised until 90% agreement was reached among the professors. Furthermore, one Turkish language teacher checked the grammar before the questionnaire was piloted and implemented. After pilot study, construct validity concern was checked through principle component analysis. The results of this analysis showed that the items in the questionnaire were loaded into a four factor solution and accounted for 39.5% of the variance. In addition, it was found that items in the adapted version of the questionnaire loaded on the factors same with the four factors in the original scale developed by Race (2001).

In order to measure the internal consistency, Cronbach's alpha for the items loaded on the inquiry-based instructional strategies factor was calculated as .81, for the items on traditional approaches factor as .74, for the items on using computers and technology in the classroom factor as .76, and for the items on self-efficacy beliefs toward science teaching factor as .72.

2.3. Data Analysis

To assess in-service teachers' beliefs in using different instructional strategies and self-efficacy beliefs in teaching science, frequencies, means, and standard deviations were determined through descriptive statistics. In addition, two-way multivariate analysis of variance (MANOVA) was used to determine the effect of sex and school type on teachers' beliefs in science teaching practices, and a multiple regression analysis was conducted to determine how well teachers' beliefs in using inquiry-based teaching strategies can be predicted by their beliefs in using traditional teaching approaches, their self-efficacy beliefs in teaching science, experience in teaching science as well as their beliefs in using technology in science classrooms. Statistical analyses were conducted at the .05 significance level.

2.4. Procedure

Before the implementation of the questionnaire, necessary permissions were provided by the elementary school administrators. The researchers also contact with the teachers selected randomly from public and private schools. The aim of the study was described and in-service teachers were asked whether they would voluntarily participate in the study. The questionnaire package consisted of two parts, namely the Teacher Beliefs toward Instructional Pedagogies Questionnaire and demographic information form. In addition, a cover letter and informed consent form were attached to the questionnaires. Teachers who volunteered to participate in the study filled out the questionnaires in their break hours at schools and returned them in packets. It took approximately 20 minutes to complete the questionnaire with demographic information. Data were collected during the spring and fall semester of 2006-2007 academic years. Before the analysis was conducted, the informed consent forms were removed from the questionnaires to ensure the anonymity of the participants.

3. RESULTS

3.1. In-service Elementary School Teachers' Beliefs in Science Teaching Practices

In order to answer first research question, that is to determine participants' beliefs in using different instructional strategies and their self-efficacy beliefs in teaching science frequencies, means, and standard deviations were calculated. The percentages based on the items in the Teacher Beliefs toward Instructional Pedagogies Questionnaire are given in Table 2. Note that, the summation of the percentages for the 'Agree' and 'Strongly Agree' choices for each item is accepted as favoring the given idea whereas, the summation for the 'Strongly Disagree' and 'Disagree' regarded as not favoring the idea in the given statement.

The results of descriptive statistics showed that the participants had strongly favorable beliefs in using inquiry based teaching strategies in their science classrooms. The mean score of participants' responses on this dimension was calculated as 4.37 with a standard deviation of 0.35. Furthermore, the frequency analysis reflected that more than 80.0 percent of the participants believed that they should provide students with the opportunity to construct their own understanding of science concepts (91.9%), and students' learning should be facilitated by exploring problems and testing ideas about possible solutions (91.8%). In addition, elementary teachers believed that science teaching should develop students' ability to identify and solve problems generated from real-life situations (84.3%). The results also revealed that most of these elementary school teachers strongly agreed that students' scientific ability could be strengthened by developing his/her inquiry skills (61.5%).

Regarding the participants' beliefs in using traditionally designed instructional strategies, it could be noted that the participants did not hold strong favorable beliefs in using these strategies in order to facilitate students' learning of scientific concepts ($M=3.06$, $SD=0.64$). To be more specific, less than half of the participants agreed that students learn best in science through teacher explanations (34.3%) or from textbooks (7.8%). Similarly, few teachers (26.0%) supported the idea that textbooks should be the primary instructional tool for science teaching. However, when it comes to spending

time on recall of facts (58.4%), and drill and practice (82.2%) in order to monitor students' science learning, relatively large number of teachers favored the effectiveness of those strategies.

Table 2: In-service Elementary School Teachers' Beliefs in Science Teaching Practices

	SD 1	D 2	U 3	A 4	SA 5
Beliefs in Inquiry Based Teaching Strategies					
Science skills and activities foster a connection between application and understanding.	1.5	1.0	3.6	49.0	44.9
Teachers should provide students with the opportunity to develop and build upon their own understanding of science concepts.	0.5	1.0	6.6	50.1	41.8
Students learn best in science when they are allowed to explore problems and test ideas about possible solutions.	0.5	1.5	6.2	43.1	48.7
A student's scientific ability is strengthened by developing his/her inquiry skills.	0.5	0.5	3.1	34.4	61.5
The primary purpose of science is to develop the ability to identify and solve problems generated from real-life situations.	0.0	6.1	9.6	37.1	47.2
Reflective thought is an important criterion in science learning activities.	0.0	0.5	4.6	40.3	54.6
Problem solving can be facilitated by students working in groups.	0.5	3.6	8.3	50.0	37.5
Beliefs in Traditional Teaching Strategies					
Students learn best in science through teacher explanations.	8.3	40.1	17.2	26.0	8.3
The textbook should be the primary instructional tool for science teaching.	12.8	44.6	16.4	22.6	3.6
If more time could be spent on recall of facts, students would do better in science.	3.6	15.7	22.3	41.6	16.8
If more time could be spent on drill and practice, students would be better in science.	0.5	7.6	9.6	47.7	34.5
Students learn best in science through science textbooks.	20.6	59.3	12.4	5.7	2.1
Beliefs in Technology-Enhanced Teaching Strategies					
Using computers for learning takes students away from important instructional time.	32.1	47.4	8.2	7.7	4.6
I do not believe the quality of science education is improved by the use of technology.	24.4	28.4	5.6	22.8	18.8
I am concerned that technology might interfere with student interactions.	20.8	34.5	24.9	14.7	5.1
I really enjoy using computers and the Internet instructionally.	1.0	2.5	9.3	56.2	30.9
Students should be able to use computers to help them solve problems in mathematics and science.	0.0	1.5	12.7	54.8	31.0
Students can use computers and technology to help make informed decisions.	1.0	4.1	14.4	59.0	21.5
Self-Efficacy Beliefs					
I understand science concepts well enough to be effective in teaching science for my grade level.	0.5	0.0	9.7	59.5	30.3
I am confident in my understanding and teaching of scientific concepts.	0.0	0.5	10.2	63.3	26.0
When a student has difficulty understanding a science concept, I sometimes do not know how to help the student understand it better.	10.2	41.8	15.8	27.6	4.6

Considering the participants' beliefs in using technology-enhanced instructional strategies, the results of descriptive statistic indicated that elementary school teachers had moderately favorable beliefs in using those strategies in their science classrooms. The mean score of participants' responses for this dimension was found as 3.99 with a standard deviation of 0.55. With regard to the results of frequency analysis, it was seen that more than half of the participants supported the idea of using technology in order to improve the quality of science education (52.8%). Additionally, large number

of participants indicated that they really enjoy using computers and the Internet for instructional purposes (87.1%). However, participants were undecided on the statement that technology might interfere with student interactions (24.9%).

Looking at participants' self-efficacy beliefs toward science teaching, the mean score of 3.96 with a standard deviation of 0.46 reflected that elementary school teachers held favorable self-efficacy beliefs. According to the results of the frequency analysis, more than 80.0 percent of the participants proposed that they understand science concepts well enough to effectively use them in their teaching (89.8%), and they feel confident enough in their understanding and teaching of scientific concept (89.3%).

3.2. In-service Elementary School Teachers' Beliefs in Science Teaching Practices with respect to Sex and School Type

A Two-way Multivariate Analysis of Variance (MANOVA) was performed to investigate the differences in elementary school teachers' beliefs in science teaching practices with respect to sex and school type. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity, with no serious violations noted. The results revealed that there was a statistically significant effect of school type that is working at public and private schools on the combined dependent variables ($F(4, 189) = 3.497, p = .009$; Wilks' Lambda = .931; partial eta squared = .069). When the results for dependent variables were considered separately, the only difference to reach statistical significance by using a Bonferroni adjusted alpha level of 0.013 was self-efficacy beliefs in science teaching ($F(1, 192) = 12.296, p = .001$; partial eta squared = .060). An examination of mean scores indicated that in-service teachers working at private schools ($M=4.15, S.D=0.47$) had higher levels of self-efficacy beliefs in science teaching than the teachers working at public schools ($M=3.77, S.D=0.62$).

The results also showed a statistically significant difference between female and male in-service teachers on the combined dependent variables ($F(4, 189) = 2.711, p = .031$; Wilks' Lambda = .946; partial eta squared = .054). However, when the results for dependent variables were examined separately, there was no difference to reach statistical significance using a Bonferroni adjusted alpha level of 0.013. In other words, no gender difference observed for the beliefs in using inquiry-based teaching strategies, beliefs in traditionally designed strategies, beliefs in using technology enhanced strategies, and self-efficacy beliefs in science teaching, separately.

3.3. Significant Predictors of In-service Elementary School Teachers' Beliefs in Using Inquiry-Based Instructional Strategies

A Multiple Regression Analysis was conducted to build a model explaining how well in-service elementary school teachers' beliefs in using traditionally designed instructional strategies and technology-enhanced instructional strategies, and their experience in teaching science as well as their self-efficacy beliefs in teaching science predicted their beliefs in using inquiry-based instructional strategies. The SPSS procedures for testing the assumptions of multicollinearity and singularity among predictor variables were necessary before multiple regression analysis were conducted. High tolerance values ranging from 0.62 to 0.98 indicated that the assumption of multicollinearity was not violated. In addition, the correlation coefficients among the predictor variables ranging from $r=0.02$ to $r=0.39$ suggested the absence of singularity among these predictor variables. Thus, predictor variables including beliefs in using traditionally designed instructional strategies and technology-enhanced instructional strategies, experience in teaching science, and self-efficacy beliefs in teaching science were entered to the model to check their direct influences on beliefs in using inquiry based instructional strategies. The results revealed that the linear combination of three predictors; beliefs in using technology-enhanced instructional strategies, experience in teaching science, and self-efficacy beliefs in teaching science was significantly related to teachers' beliefs in using inquiry based instructional strategies ($R^2=0.17, F(3,175)=11.95, p<0.001$). The sample correlation coefficient was calculated as 0.42, indicating that approximately 17% of variance in beliefs in using inquiry based

instructional strategies can be accounted by the linear combination of three significant predictor variables. The standardized beta weights of 0.28, 0.20 and 0.19 showed that teachers' beliefs in using inquiry based instructional strategies were positively related to self-efficacy beliefs in teaching science, experience in teaching science, and beliefs in using technology-enhanced instructional strategies, respectively. Furthermore, the results reflected that self-efficacy beliefs in teaching science explained 11.5% of the variance in teachers' beliefs in using inquiry-based instructional strategies indicating large effect size. On the other hand, beliefs in using technology-enhanced instructional strategies and experience in teaching science explained only 3.2% and 2.5% of the variance in the related dependent variable. In addition, the results showed that the dependent variable was not significantly related to teachers' beliefs in using traditionally designed instructional strategies.

4. DISCUSSION

The present study aimed to determine in-service elementary science and classroom teachers' beliefs in using inquiry-based, traditionally designed, and technology-enhanced instructional strategies as well as their self-efficacy beliefs in science teaching. Furthermore, the effect of sex and school type on their beliefs toward science teaching practices, and significant predictors of in-service teachers' beliefs in using inquiry-based instructional strategies were investigated. The results of this study revealed that in-service teachers had favorable beliefs toward using inquiry-based and technology-enhanced teaching strategies in their science classrooms. To be more specific, in-service teachers strongly advocated that teachers should provide students some opportunities to develop their own understanding of scientific concepts and students' learning should be facilitated by exploring problems generated from real-life situations and testing ideas about possible solutions. Furthermore, the results revealed that in-service teachers showed high tendency to use technology-enhanced instructional strategies by stating that using technology will improve the quality of science education. Also, these teachers were against using traditional classroom strategies and did not believe that student could learn best by textbooks and teachers' explanations. These findings of the present study have implied that in-service elementary school teachers have a tendency to use reform oriented classroom experiences (Yun, 2007). In other words, these teachers held the necessary beliefs to fulfill the requirements of elementary science teaching which place a strong emphasis on the process or inquiry standards. However, a previous research study (Marshall, Horton, Igo and Switzer, 2009) reported that there was a gap between the time allocated for inquiry-based teaching and the ideal time that should be devoted to using this strategy in science classes. At this point, it should be noted that there might be some barriers causing this gap in science teaching. For example, Berns and Swanson (2000) pointed out that some teachers had inadequate subject matter knowledge and inquiry experiences to implement the reform-based standards. Thus, how teachers make students engage in inquiry-based instructional experiences and the role of the teachers' pedagogical knowledge in the implementation of reform-based curriculum needs to be addressed in the context of elementary science teaching in Turkey.

Consistent with previous research study (Marshall, Horton, Igo and Switzer, 2009) sex did not have a statistically significant effect on in-service teachers' beliefs in science teaching practices. On the other hand, being worked in private or public schools had a significant effect on in-service elementary school teachers' beliefs in science teaching practices. Particularly, this statistical difference was originated from the fact that the teachers working at private schools had higher self-efficacy beliefs in teaching science than those working at public schools. At this point, it should be noted that in Turkey teachers who are working at private schools have greater opportunities to use reform-based instructional materials compared to the teachers working at public schools. In other words, private schools are well equipped in terms of instructional materials and technology compared to the public schools. Hence, based on the findings we could conclude that having opportunities to use more materials in science classes might positively affect in-service teachers' self-efficacy beliefs who are working at private schools. However, further research study should be performed to examine why public school teachers held relatively low self-efficacy beliefs and which strategies might be taken in order to enhance their self-efficacy beliefs in teaching science.

The investigation of significant predictors of in-service teachers' beliefs in using inquiry-based instructional strategies reflected that those teachers' increased self-efficacy beliefs make a contribution to their beliefs in using these strategies. To be more specific, in-service teachers' self-efficacy beliefs were significantly correlated to their beliefs in using inquiry-based instructional strategies which implies that teachers who feel comfortable in teaching science also show willingness to use inquiry-based instructional strategies. As also suggested by Marshall, Horton, Igo and Switzer (2009), self-efficacy beliefs plays a crucially important but not individually sufficient role which encourages in-service teachers to provide students with inquiry-based learning environments.

Of the variables examined, experience in teaching science was among the predictors that relate significantly to elementary school teachers' beliefs in using inquiry-based instructional strategies. At this point, it plausible to advocate that experience in teaching science is an important factor which leads teachers in using inquiry-based instructional strategies. That finding was consistent with other studies in the literature indicating that experienced teachers prefer to use student-centered instructional strategies (Mayer, 2004; Sweller, 2003). In other words, the improvement of preferences toward using reform-based teaching approaches is desirable for teachers with more experience in teaching. It could be attributed to the fact that teachers who are inexperienced feel uncomfortable in using inquiry-based approaches that facilitates student-centered classroom activities compared to the experienced teachers. Thus, it seemed that pre-service teacher education programs could not make an accomplishment in increasing beliefs in creating inquiry-based learning environments.

The results also revealed that teachers who favored using technology-enhanced activities in their classes had higher beliefs in using inquiry-based instructional strategies (Darling-Hammond, 1999). According to Owens et al. (2002), use of technology favors effective implementation of inquiry-based teaching while increasing students' curiosity through visualization. Thus, teachers who had higher beliefs in using technology in science classes probably let students conduct their inquiries through technology.

To sum up, it is believed that studying how teachers' beliefs toward using inquiry-based teaching develop, how it can be well predicted with other constructs and what factors facilitate it's development could yield valuable implications for the educational field.

5. CONCLUSIONS AND IMPLICATIONS

Reform movements on elementary science education in Turkey have encouraged researchers to focus on in-service teachers' beliefs in creating inquiry-based learning environments. The recent research study showed that elementary school teachers had strong favorable beliefs in using these reform-based instructional strategies rather than traditionally-designed classroom environments in their science classes. This finding could be accepted as an indicator of time devoted to inquiry based instruction enriched by using technology in elementary science education. However, further research study should be conducted to determine whether there are some barriers in transformation of these favorable beliefs to more inquiry-based and technology-enhanced teaching, and what should be done to eradicate these barriers.

The present study also pointed out that those teachers working at public and private schools did not differ in beliefs in using inquiry-based and technology-enhanced instructional strategies as well as traditionally-designed classroom activities. However, it was found that private school teachers had significantly higher self-efficacy beliefs in science teaching than public school teachers did. In this aspect, there should be some initiatives to enhance public school teacher' self-efficacy beliefs which will have them feel comfortable in their science teaching.

Examining the significant predictors of elementary school teachers' beliefs in using inquiry-based instructional strategies, teaching experience, self-efficacy beliefs in science teaching, and beliefs in using technology-enhanced instructional strategies were three factors that relate significantly to those beliefs. In other words, teachers with more experience in teaching and having higher self-efficacy beliefs held more favorable beliefs in creating inquiry-based classroom environments. In addition, those teachers with more positive beliefs in using technology-enhanced classroom activities

also favored using inquiry-based instructional strategies. Based on these findings, we suggest that pre-service teacher education programs should stimulate future teachers' beliefs in using inquiry-based instructional strategies. These programs may provide the pre-service teachers some opportunities to practice their science teaching through inquiry which may also enhance their self-efficacy beliefs in teaching science. In addition, elementary schools should be well equipped with the necessary technological tools and teachers should be donated with the knowledge base in order to use them effectively. By the way, these opportunities may also make a contribution to teachers' inquiry-based classroom practices.

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Geniş Özet

Bu çalışmanın amacı ilköğretim okullarında görev yapan öğretmenlerin fen öğretiminde sorgulamaya dayalı öğretim stratejilerini, teknolojiye dayalı öğretim stratejileri ile geleneksel öğretim yöntemlerinin kullanımına yönelik inançlarını tespit etmek ve fen öğretimine yönelik öz-yeterlik

algılarını belirlemektir. Ek olarak, bu öğretmenlerin belirtilen inançlarına cinsiyet ve okul tipinin etkisi incelenmiş ve son olarak, sorgulamaya dayalı öğretim stratejilerinin kullanımına yönelik inançların istatistiksel olarak anlamlı belirleyicileri tespit edilmeye çalışılmıştır.

Bu amaçlar doğrultusunda, veriler ‘Öğretim Pedagojilerine Yönelik Öğretmen İnançları Ölçeği’nin Türkçe’ye adaptasyonu ile elde edilmiştir. Ölçek 5’li Likert-tipi toplam 31 madde içermekte ve 4 alt boyuttan oluşmaktadır. Bu boyutlar sorgulamaya dayalı (10 madde), teknolojiye dayalı (8 madde), ve geleneksel öğretim stratejilerinin (7 madde) kullanımına yönelik inançlar ve fen öğretimine yönelik öz-yeterlik algısı (6 madde) olarak isimlendirilmiştir. Çalışma rastgele seçilmiş toplam 197 ilköğretim okulu öğretmenin katılımıyla gerçekleştirilmiştir. Katılımcıların 54’ü (%27.4) ilköğretim fen bilgisi, 143’ü (72.6%) sınıf öğretmeni olup devlet okullarında (N=133 (67.5)) ya da özel okullarda (N=64 (%32.5)) çalışmaktadırlar. Ek olarak, katılımcıların yarısından fazlası 10 veya daha az senelik öğretmenlik tecrübesine sahiptir. Öğretmenlerin farklı öğretim stratejilerinin kullanımına yönelik inançları ile fen öğretimine yönelik öz-yeterlik algılarını belirlemek için frekanslar, ortalama puanlar ve standart sapmalar betimsel istatistik yoluyla hesaplanmıştır. Öğretmenlerin fen öğretimi ile ilgili inançları üzerine cinsiyetin ve okul tipinin etkisi ise iki-yönlü çoklu varyans analizi (MANOVA) ile incelenmiştir. Çoklu regresyon analizi aracılığıyla da öğretmenlerin sorgulamaya dayalı öğretim stratejilerinin kullanımına yönelik inançlarının anlamlı belirleyicileri tespit edilmiştir.

Betimsel istatistik analiz sonuçlarına göre katılımcılar fen öğretiminde sorgulamaya dayalı öğretim stratejilerinin kullanımı üzerine olumlu yönde güçlü inançlara sahiptir. Bu boyut ile ilgili ortalama puan 4.37, standart sapma ise 0.35 olarak hesaplanmıştır. Aynı zamanda, katılımcıların %80’inden fazlası öğrencilerin fen kavramları üzerine anlayışlarını kendilerinin yapılandırması için öğretmenlerin yardımcı olması gerektiğini düşünmektedir. Katılımcılara göre, öğrenciler problemleri araştırarak ve olası çözüm yollarını test ederek fen kavramlarını daha iyi öğrenirler. Bu çalışmada yer alan öğretmenlerin, 3.06 olarak hesaplanan ortalama puana göre geleneksel öğretim yöntemlerinin kullanımına yönelik güçlü inançlara sahip olmadıkları belirlenmiştir. Ek olarak, katılımcıların yarısından fazlası öğrencilerin fen kavramlarını ders kitapları ve öğretmenlerin açıklamalarıyla en iyi şekilde öğrendikleri fikrine karşı çıkmıştır. Teknoloji kullanımına yönelik öğretim stratejileri üzerine inançlar değerlendirildiğinde ise ilköğretim okulları öğretmenlerinin bu stratejiler ile ilgili olumlu inançlara sahip oldukları tespit edilmiştir. Frekans analizi sonuçları, katılımcıların teknoloji kullanımıyla birlikte fen eğitiminin kalitesinin artacağını düşündüklerini göstermiştir. Aynı zamanda, katılımcıların birçoğu fen öğretiminde internet ve bilgisayar kullanmanın zevkli olduğunu belirtmiştir. Bu sonuçlara ek olarak, betimsel istatistik analizi sonuçları, ilköğretim okulları öğretmenlerinin fen öğretimine yönelik öz-yeterlik algılarının olumlu olduğunu göstermiştir. Katılımcıların %80’inden fazlası etkin eğitim verebilmek için fen kavramlarını yeterince iyi anladıklarını düşünmektedir.

İki-yönlü çoklu varyans analizi sonuçlarına göre, okul tipinin bağımlı değişkenlerin bütünü üzerine istatistiksel olarak anlamlı etkisi vardır ($F(4, 189) = 3.497, p = .009$; Wilks’ Lambda = .931; partial eta squared = .069). Sonuçlar, her bir bağımlı değişken için ayrı olarak incelendiğinde ise istatistiksel olarak anlamlı fark sadece fen öğretimine yönelik öz-yeterlik algısı üzerine bulunmuştur. Bir başka deyişle, özel okullarda çalışan öğretmenlerin devlet okullarında çalışan öğretmenlere göre fen öğretimi üzerine daha olumlu öz-yeterlik algısına sahip oldukları tespit edilmiştir. Sonuçlar, aynı zamanda cinsiyetin de bağımlı değişkenlerin bütünü üzerine istatistiksel olarak anlamlı etkisinin olduğunu işaret etmiştir ($F(4, 189) = 2.711, p = .031$; Wilks’ Lambda = .946; partial eta squared = .054). Ancak, bu bağımlı değişkenler için ayrı olarak incelendiğinde cinsiyet farkının olmadığı görülmüştür.

Çoklu regresyon analizi sonuçları ise teknolojiye dayalı öğretim stratejilerinin kullanımına yönelik inançlar, öğretmenlik tecrübesi ve fen öğretimine yönelik öz-yeterlik algısı olmak üzere üç değişkenin sorgulamaya dayalı öğretim stratejilerinin kullanımına yönelik inançların istatistiksel olarak anlamlı belirleyicisi olduğunu göstermiştir ($R^2=0.17, F(3,175)=11.95, p<0.001$). Korelasyon katsayısı 0.42 olarak hesaplanmış olup bağımlı değişken için toplam varyasyonun %17’sinin üç belirleyici değişken tarafından açıklandığını göstermektedir.

Bu çalışmada elde edilen bulgulara göre, ilköğretim okullarında çalışan öğretmenler fen öğretimindeki reformlara dayalı sınıf-içi etkinlikleri kullanmak için gerekli inançlara sahiptir. Bu öğretmenler, sorgulayarak öğrenmenin önemini vurgulayan ilköğretim fen müfredatının gerekliliklerini yerine getirme eğilimindedirler. Ancak, yapılan bir çalışma (Marshall, Horton, Igo and Switzer, 2008) sorgulamaya dayalı öğretime gerçekte ayrılan zaman ile bu öğretime ayrılmak istenen zaman arasında fark olduğunu göstermiştir. Bu durumda, öğretmenlerin sorgulamaya dayalı etkinlikleri uygulama konusunda karşılaştıkları engelleri de göz önünde bulundurmak gerekir. Sorgulamaya dayalı öğretim yöntemlerinin kullanımına yönelik inançları belirleyen faktörler incelendiğinde ise, öğretmenlikte tecrübesi ile yüksek öz-yeterlik algısının öğretmenlerin bu öğretim yöntemlerini kullanmaya yönelik inançlarına olumlu yönde katkısı olduğu tespit edilmiştir. Bu sonuçlar doğrultusunda öğretmen yetiştirme programlarının öğretmen adaylarına reforma dayalı öğretim yöntemlerinin kullanımını konusunda olanaklar sağlanması gerekliliği doğmuştur. Diğer bir deyişle, öğretmen adayları sorgulamaya dayalı etkinliklerin fen kavramlarının öğretiminde etkin bir faktör olduğu yönünde motive edilmelidir. Aynı zamanda, öğretmen adaylarına bu tür etkinlikleri geliştirip uygulayabilecekleri ve bu konudaki bilgilerini geliştirebilecekleri uygun ortamlar sunulmalıdır. Bu çalışmada elde edilen bir başka sonuca göre, öğretmenlerin sorgulamaya dayalı etkinliklerin kullanımına ve teknoloji kullanımına yönelik inançları birbirlerini desteklemektedir. Bu nedenle, öğretmenleri sınıf-içi etkinliklerde teknolojiyi kullanmaya teşvik etmek için yapılan her tür girişim sorgulamaya dayalı öğretim yöntemlerinin kullanımına yönelik inançlarına da katkı sağlayacaktır.