

Primary Student Teachers' Teaching-Learning Conceptions, Attitudes and Self-Efficacy Beliefs toward Science Teaching

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ABSTRACT

Science education plays an important role at primary school level. Primary school teachers are the first to introduce science to students. Teaching-learning conceptions, attitudes and perceived self-efficacy of teachers towards science teaching are influential on pupils' science learning. The aim of this study was to investigate primary student teachers' (PSTs') teaching-learning conceptions, attitudes, and self-efficacy beliefs toward science teaching. The sample consisted of 231 PSTs from a public university in Turkey. The Attitude toward Science Teaching Scale, Science Teaching Self-Efficacy Belief Instrument, and Teaching-Learning Conceptions Questionnaire were used for data collection. Descriptive statistics, multivariate analysis of variance, and Pearson correlation analysis were utilized for analyzing the data. Results revealed that PSTs exhibited a constructivist teaching-learning approach rather than a traditional teaching-learning approach. PSTs' mean scores on science teaching self-efficacy beliefs and attitudes toward science teaching were found higher than the average. Females were more dominant than males in terms of the teaching-learning approach. Moreover, it was found out that the female's science teaching self-efficacy beliefs and outcome expectancy were higher than the males.

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Introduction

Science education plays an important role in the development of scientifically literate citizens in the fourth industrial revolution. It is primary school teachers who first introduce science concepts to learners. Primary school teachers have an important task in inculcating pupils with the 21st century skills of scientific literacy, and researching, investigating, questioning, analyzing and using higher-order thinking skills. Pupils' attitudes toward science begin to take shape in the primary school science classroom. In this period, PSTs play a vital role in developing students' positive attitudes toward science. PSTs should have positive attitudes toward science in order to teach science in an effective way as their attitudes toward science affect their pupils' attitudes toward science lessons (Tekbıyık & İpek, 2007). In this way, pupils' interest in science can be increased which may ultimately lead to them entering science-related professions (George, 2006).

According to Bandura (1986), it is essential to determine people's beliefs as well as their skills, abilities, and knowledge. Bandura's self-efficacy construct has been reported to be associated with teachers' instructional decisions and teaching performance (Bandura, 1997). It has been indicated that

teachers with a low sense of teaching efficacy often develop anxiety and poor attitudes toward the subject matter, tend to devote less instructional time to that particular subject matter, and adopt more teacher-directed instructional approaches (Bandura, 1997; Deehan, 2016; Nie, Tan, Liao, Lau, & Chua, 2013). There are many factors that influence pupils' attitudes toward science. In their study, Osborne, Simon and Collins (2003) listed as factors affecting learners' attitudes towards science gender, personal characteristics, the teacher and curriculum, and difficulties in comprehending science. Among them, the teacher has a significant impact on students' attitudes toward science. Teachers' attitudes toward science teaching is one of the important factors affecting science teaching (Wenner, 1993) and In addition, teachers' attitudes toward teaching science also affect their classroom practices (Özdemir & Kaptan, 2013). This situation is directly related to teachers' science teaching self-efficacy levels. In their study, Enochs and Riggs (1990) state that student teachers having high self-efficacy levels preferred to use student-centred activities in science teaching. Studies have also shown that teachers having a high level of self-efficacy toward science teaching use student-centred approaches and prefer inquiry-based science teaching methods (Schunk, 2008). On the other hand, it has been determined that teachers with low self-efficacy levels in science teaching prefer to use teacher-centred approaches such as reading information from the book and direct verbal instruction (Denizoğlu, 2008). In a study conducted by Chan (2003), it was found that individuals with high self-efficacy levels teach more effectively and experience less stress than individuals with low self-efficacy levels. There are important behavioural differences in the classroom between PSTs who have high and low self-efficacy beliefs. According to Özkan et al. (2002), a belief in science teaching self-efficacy leads to more effective science teaching and increases pupil success.

Studies on the factors affecting attitudes toward science teaching have concluded that these begin to take shape during the pre-service phase (Haney, Czerniak, & Lumpe 1996). Contributing factors at the undergraduate level include previous science knowledge, achievement levels in science courses, gender, family characteristics, teacher attitudes they were exposed to, and the science classroom learning environment they were in, including whether they engaged in experiments. At the university level, the attitudes of student teachers toward science and science teaching and their attitudes toward science teachers affect the development of their attitudes towards science teaching (Özdemir & Kaptan, 2013; Thomas & Pedersen, 2003).

Many studies show that teachers' attitudes toward science significantly affect pupils' attitudes toward science lessons (Bloom, 1989; Palmer, 2001). Another factor affecting the positive attitude toward science is the teaching approach used. An effective teaching environment increases positive attitudes towards science (Papanastasiou, 2002). At this point, the teaching-learning approach adopted by teachers becomes important. According to Chan and Elliot (2004), the concept of teaching-learning conceptions refers to teachers' preferences to address teaching and learning paths. That is, the conception of the teaching-learning dynamic corresponds to beliefs teachers have about their educational practices (Chan, 2003). Philosophical developments in educational sciences cause a difference in the teaching-learning approach. There are two general teaching-learning approaches (Schunk, 2008), referred to as traditional and constructivist teaching-learning approaches (Aypay, 2011; Bıkmaz, 2011; Chan & Eliot, 2004; Cheng, Chan, Tang, & Cheng, 2009; Schunk, 2008; Oğuz, 2011; Şahin & Yılmaz, 2011).

Teachers are nowadays encouraged to adopt a student-centred teaching approach rather than a teacher-centred approach in order to teach effectively and efficiently (National Research Council [NRC], 2012). The constructivist teaching-learning approach focuses on learner-centered teaching in which individuals build meaning by combining their existing knowledge with new ideas. Learning is mostly seen as creating meaning, which is created by the learner rather than being dictated (Biggs, 1996). Learners process and incorporate information individually (Saban, 2004). The purpose of the constructivist approach is to ensure the development of high-level cognitive skills in addition to ensuring that learning is meaningful and permanent (Şaşan, 2002). Constructivist learning environments require students to be active throughout the learning process. Teachers are not seen as

the presenter of knowledge, but rather as a guide to help students construct knowledge and discover meaning (Dunlop & Grabinger, 1996; Martin, 2009).

Conversely, in the traditional teaching-learning approach, teachers transfer information to learners as a source of information in the classroom, and pupils receive this information without questioning (Özden, 2003; Senemoğlu, 2004). Teachers adopting the traditional teaching-learning approach use teacher-centred teaching strategies in the classroom and regard pupils as passive recipients of knowledge (Chen & Elliot, 2004; Cheng et al., 2009). In traditional classrooms, teachers are the sole authority and source of knowledge; the teaching-learning process is directed only by the teacher (Brooks & Brooks, 1999). Such an environment does not allow the active participation of students in the process of creating knowledge. Teachers who follow a traditional teaching-learning approach strive to hear the only correct answer from pupils when they ask questions in the classroom. Since the pupils in this class merely memorise information, it is not possible for them to learn meaningfully and properly.

Given the goals of the updated science curriculum in Turkey (Ministry of National Education [MoNE], 2013; 2018), it is incumbent upon science teachers and primary school teachers to develop scientifically literate pupils who possess scientific knowledge, attitudes, and inquiry and higher-order thinking skills. In the 2013 Turkish science curriculum, science as a subject begins in the 3rd and 4th grades where it is taught by primary school teachers. For this reason, science teaching self-efficacy, attitude toward science teaching, and teaching-learning conceptions of primary teachers become important in relation to achieving the goals of the curriculum. PSTs' attitude and self-efficacy beliefs towards science teaching can affect the quality of teaching, teaching methods and techniques used, students' participation in learning, and efficiency of the teaching process. In order to make science education more effective and efficient, it accordingly becomes necessary to determine PSTs' attitudes toward science teaching, and their science teaching self-efficacy belief levels and teaching-learning conceptions.

This study aimed to determine the PSTs' teaching-learning conceptions, attitudes and self-efficacy beliefs toward science teaching according to gender and grade level variables and to reveal the relationships between them. Accordingly, The following research questions were addressed in this study.

1. Is there a significant difference in PSTs' teaching-learning conceptions, attitudes and self-efficacy beliefs towards science teaching with respect to their grade level?
2. Is there a significant difference in PSTs' teaching-learning conceptions, attitudes and self-efficacy beliefs towards science teaching ' with respect to their gender?
3. Is there a relationship among PSTs' teaching-learning conceptions, attitudes and self-efficacy beliefs towards science teaching?

Methods

This research was designed quantitatively using a survey research design. A survey is a research design that aims to describe a current situation as it exists (Fraenkel, Wallen & Hyun, 2012).

Study Group

The sample consisted of 231 PSTs attending to 1st, 2nd, 3rd, and 4th grades of the 4-year primary teacher education programme at a public university located in the Central Anatolian Region of Turkey. The sample group was selected by a convenience sampling method because of easy access, and limited cost and time conditions (Fraenkel et al., 2012). The sample included 177 (76.6%) female and 54 (23.4%) male PSTs. Majority of the group consisted of female PSTs because this undergraduate program is more preferred by females. Sixty-nine PSTs (29.9%) were enrolled in the first year of the programme, 43 (18.6%) in the second year, 73 (31.6%) in the third and 46 (19.9%) in the fourth. lease

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Data Collection

Data were collected using the Attitudes toward Science Teaching Scale, Science Teaching Self-Efficacy Belief Instrument, and Teaching-Learning Conceptions Questionnaire. Prior to administration of the data collection tools, the PSTs were given detailed information about the purpose of the research and ensured of their voluntary participation and confidentiality of data. They were given about half an hour to respond to the instruments. Reliability values of the scales used in the study were calculated using Cronbach's alpha coefficient. Alpha coefficients above 0.70 were considered as indicative of adequate reliability (Büyüköztürk, 2012). Confirmatory factor analysis was conducted to validate the factor structure of the instruments. Model fit was assessed using chi-square to degrees of freedom ratio (χ^2/df), root mean square error of approximation (RMSEA), standardised root mean square residual (SRMR), comparative fit index (CFI), goodness of fit index (GFI), and adjusted goodness of fit-index (AGFI). A computed χ^2/df value smaller than 5, RMSEA and SRMR values below 0.05, and CFI, GFI and AGFI values above 0.90 indicate a good fit (Hu & Bentler, 1999; Kline, 2011). However, RMSEA and SRMR values below 0.10, GFI value above 0.85 and AGFI value above 0.80 could also be considered as acceptable for model fit (Anderson & Gerbing, cited in Duyan & Gelbal, 2013).

Attitudes toward Science Teaching Scale

In order to determine PSTs' attitudes toward science teaching the Attitudes toward Science Teaching Scale was used. This scale was originally developed by Thompson and Shringley (1986) and adapted into Turkish by Özkan, Tekkaya and Çakıroğlu (2002). It included 21 items rated on a five-point Likert scale ranging from 1 (totally disagree) to 5 (totally agree). Its Cronbach alpha reliability value was computed as .80. In the current study, reliability coefficient was calculated as .77, indicating an appropriate reliability (Büyüköztürk, 2012). Confirmatory factor analysis results confirmed unidimensionality of the Attitudes toward Science Teaching Scale ($\chi^2/df = 1.81$, RMSEA = .060, SRMR = .074, CFI = .96, GFI = .90, AGFI = .86).

Science Teaching Self-Efficacy Belief Instrument

In order to determine PSTs' science teaching self-efficacy, Science Teaching Self-Efficacy Belief Instrument was used. This instrument was originally developed by Riggs and Enochs (1990) and adapted into Turkish by Bıkmaz (2002). It is a 21-item five-point Likert scale anchored with 1= totally disagree and 5= totally agree. It has two dimensions: personal science teaching self-efficacy belief (n=13 items) and science teaching outcome expectancy (n=8 items) Reliability coefficient was found as .89 for the first dimension, .69 for the second dimension and .85 for the whole scale. In the current study, reliability coefficient was computed as .67 for the first dimension, .65 for the second dimension and .77 for the whole scale. These values are reliable enough to perform the analyses (Büyüköztürk, 2012). Confirmatory factor analysis results supported the two-factor structure of the Science Teaching Self-Efficacy Belief Instrument ($\chi^2/df = 1.82$, RMSEA = .061, SRMR = .075, CFI = .93, GFI = .88, AGFI = .84).

Teaching-Learning Conceptions Questionnaire

In order to determine PSTs' teaching-learning conceptions Teaching-Learning Conceptions Questionnaire was used. It was developed by Chan and Elliot (2004) and adapted into Turkish by Aypay (2011). This scale consists of 30 items rated on a five-point Likert scale ranging between 1

(totally disagree) and 5 (totally agree). It has two sub-dimensions: The constructivist teaching-learning approach (n= 12 items) and traditional teaching-learning approach (n= 18 items). The reliability coefficient was calculated as .88 for the constructivist teaching-learning approach dimension, .83 for the traditional teaching-learning approach dimension and .71 for the whole scale. In the present research, reliability coefficient was computed as .86 for the constructivist teaching-learning approach dimension, .83 for the traditional teaching-learning approach dimension and .84 for the whole scale, revealing a good reliability (Büyüköztürk, 2012). Confirmatory factor analysis results supported the two-factor structure of the Teaching-Learning Conceptions Questionnaire ($\chi^2/df = 1.89$, RMSEA = .065, SRMR = .12, CFI = .94, GFI = .82, AGFI = .78).

Data Analysis

The quantitative data obtained in the research were analyzed using the SPSS 22.0 software package programme. Descriptive statistics, one-way analysis of variance (ANOVA), multivariate analysis of variance (MANOVA), and Pearson correlation analysis were used. Two separate ANOVAs were performed to determine whether the PSTs' attitudes toward science teaching differed with respect to gender and grade level. Four separate MANOVAs were conducted to examine whether the PSTs' levels of science teaching self-efficacy and teaching-learning conceptions differed according to the same variables. Pearson correlation analysis was used to reveal the relationships between science teaching self-efficacy, teaching-learning conceptions, and attitudes towards science teaching. All appropriate assumptions were tested and satisfied prior to each analysis. An alpha level of 0.05 was used to determine statistical significance. As a measure of effect size for ANOVA and MANOVA, partial eta squared value was interpreted as small ($.01 < \eta^2 < .06$), medium ($.06 < \eta^2 < .14$), and large ($\eta^2 > .14$). Correlation coefficients were interpreted as small ($.10 \leq r < .30$), medium ($.30 \leq r < .50$), and large ($r \geq .50$) (Green & Salkind, 2014).

Findings

PSTs' Teaching-Learning Conceptions, Attitudes and Self-Efficacy Beliefs towards Science Teaching with Respect to Grade Level

Descriptive statistics shown in Table 1 indicate that the PSTs generally held a constructivist teaching-learning approach ($X=4.28$) rather than a traditional teaching-learning approach ($X=3.02$). PSTs' personal science teaching efficacy belief ($X=3.50$) and science teaching outcome expectancy ($X=3.41$) levels were above average. PSTs' attitudes toward science teaching ($X=3.08$) were at intermediate level.

Table 1

Test of Between Subject Effects According to PSTs' Year level

Dimensions	Grade Level	X	Sd	n	F	p
Attitudes toward Science Teaching	1	3.00	.43	66	1.36	.257
	2	3.09	.41	41		
	3	3.09	.52	73		
	4	3.18	.43	45		
Personal Science Teaching Efficacy Belief	1	3.61	.41	69	3.31	.021*
	2	3.43	.41	41		
	3	3.40	.53	73		
	4	3.52	.37	42		
Science Teaching Outcome	1	3.39	.46	69	1.58	.196

Expectancy	2	3.36	.46	41	3.33	.020*		
	3	3.39	.60	73				
	4	3.56	.37	42				
Constructivist Teaching-Learning Approach	1	4.41	.37	65				
	2	4.32	.55	38				
	3	4.11	.81	72				
	4	4.42	.59	93				
Traditional Teaching-Learning Approach	1	2.74	.53	65			4.15	.007*
	2	3.06	.59	38				
	3	3.22	.64	72				
	4	3.12	.73	39				

ANOVA results in Table 1 shows that there is no significant mean difference in PSTs' attitudes toward science teaching at the 95% confidence interval ($p < .05$) with respect to year of study, $F(6,410)=1.36$, $p=.257$, partial eta squared=.018.

However, MANOVA results demonstrated a significant difference in PSTs' science teaching self-efficacy beliefs at the 95% confidence interval ($p < .05$) with respect to year of study [Wilks' Lambda=.943, $F(6,432)=2.14$, $p=.048$, partial eta squared=.029]. The Post-Hoc Tukey test revealed a statistically significant difference between 1st and 3rd year students ($p=.022$).

MANOVA results also revealed a significant difference in PSTs' teaching-learning conceptions by year of study [Wilks' Lambda=.903 $F(6,410)=3.58$ $p=.002$, partial eta squared=.050]. The Post-Hoc Tukey test again indicated a statistically significant difference between the 1st and 3rd year students ($p=.018$) and between 3rd and 4th year students ($p=.047$).

PSTs' Teaching-Learning Conceptions, Attitudes and Self-Efficacy Beliefs towards Science Teaching with Respect to Gender

ANOVA results in Table 2 demonstrate no significant difference in PSTs' attitudes toward science teaching in relation to gender [$F(1,524)=2.46$, $p=.118$, partial eta squared=.011].

Table 2

Subject Effects According to PSTs' Gender

Dimensions	Gender	X	Sd	n	F	p
Attitudes toward Science Teaching	Female	3.11	.46	174	2.46	.118
	Male	3.00	.47	51		
Personal Science Teaching Efficacy Belief	Female	3.57	.39	172	11.14	.001*
	Male	3.27	.55	53		
Science Teaching Outcome Expectancy	Female	3.46	.46	172	3.60	.059
	Male	3.28	.58	53		
Constructivist Teaching-Learning Approach	Female	4.42	.48	163	13.94	<.001*
	Male	3.90	.85	51		
Traditional Teaching-Learning Approach	Female	3.09	.66	163	8.22	.005*
	Male	2.83	.55	51		

MANOVA results showed a significant difference in PSTs' science teaching self-efficacy beliefs by gender [Wilks' Lambda=.95, $F(2,216)=5.59$, $p=.004$, partial eta squared=.049]. Female PSTs' means scores on both personal science teaching efficacy belief and science teaching outcome expectancy dimensions were higher than those of males. The Gender difference in the personal science teaching

efficacy belief dimension was found statistically significant ($p=.001$), however, it was not found statistically significant in the science teaching outcome expectancy dimension ($p=.059$).

PSTs' teaching-learning conceptions were also found significantly different by gender [Wilks' Lambda=.89, $F(2,205)=13.32$, $p<.001$, partial eta squared=.115]. Female PSTs' mean scores on teaching-learning conceptions were higher than those of males. Statistically significant differences in both constructivist ($p<.001$) and traditional ($p=.005$) teaching-learning approaches were detected.

Relationships among Teaching-Learning Conceptions, Attitudes toward Science Teaching, and Science Teaching Self-Efficacy Beliefs

Pearson correlation analysis revealed a strong positive association between the PSTs' attitudes toward science teaching and their science teaching self-efficacy beliefs ($r=.58$, $p<.001$). PSTs' attitudes toward science teaching was also found positively and highly related to their personal science teaching efficacy belief ($r=.50$, $p<.001$) and science teaching outcome expectancy ($r=.57$, $p<.001$) dimensions of science teaching self-efficacy beliefs. Weak relationships were detected between PSTs' attitudes toward science teaching and their adoption of constructivist teaching-learning approaches ($r=.13$, $p=.05$) or traditional teaching-learning approaches ($r=.18$, $p=.009$).

Pearson correlation analysis further demonstrated a moderate positive relationship between PSTs' science teaching self-efficacy beliefs and the adoption of the constructivist teaching-learning approach in science teaching ($r=.45$, $p<.001$). Dimensions of science teaching self-efficacy beliefs were also significantly and positively related with the constructivist teaching-learning approach. There was a high relationship between personal science teaching efficacy belief and constructivist teaching-learning approach ($r=.47$, $p<.001$) and a moderate relationship between science teaching outcome expectancy and constructivist teaching-learning approach ($r=.35$, $p<.001$). However, relationship between science teaching self-efficacy beliefs and the use of the traditional teaching-learning approach was not found statistically significant.

Discussion and Conclusion

Findings of this study revealed that the PSTs' attitudes toward science teaching were generally positive. This is consistent with other studies in the literature which reported positive attitudes toward science teaching among student teachers (Bayraktar, 2011; Denizoglu, 2008; Duban & Gökçakan, 2012; Eric, Richard, & Badu, 2018; Genç, Deniz & Demirkaya, 2010; Taşdemir & Kartal, 2013; Türkmen, 2002; Weinburgh, 1995). The results also revealed that PSTs' attitudes toward science teaching were not significantly different according to gender. This result is again consistent with the literature revealing a non-significant association between gender and attitudes toward science teaching (Ateş, 2019; Altınok, 2004; Denizoglu, 2008; Eric et al., 2018; Genç et al., 2010; Kahyaoğlu & Fire, 2007; Sarıkaya, 2004; Tekbıyık & İpek 2007; Türkmen, 2002, 2008) (but cf. Özdemir and Kaptan (2013) who found a gender difference in attitudes toward science teaching and Arıcı Dağ (2019) who showed that female student teachers' attitudes toward science teaching were significantly more positive than that of males).

In the present study, PSTs' attitudes toward science teaching were not significantly different across years of study. This finding aligns with the conclusions of a study conducted by Ateş (2019). However, some studies in the literature have shown that attitudes toward science teaching differ significantly by year of study (Denizoglu, 2008; Duban & Gökçakan, 2011; Özdemir & Kaptan, 2013; Türkmen & Bonnstetter, 1999). These studies revealed that fourth-year students held more positive attitudes towards science teaching than did first-year students.

The findings of the current study show that PSTs' personal science teaching efficacy beliefs and science teaching outcome expectations are above average Güvenç likewise (2011) found that self-efficacy levels of PSTs were high. Some previous studies (Ocak, Ocak, & Kalender, 2017; Özdilek & Bulunuz, 2009; Yener & Yılmaz, 2017) found that student teachers' science teaching self-efficacy beliefs

were at medium level. This study revealed that PSTs' science teaching self-efficacy beliefs differed by gender, female PSTs' science teaching self-efficacy beliefs and outcome expectations being higher than that of males. This finding is in parallel with the results of the research conducted by Hamurcu (2006), while it contradicts with the results of the previous studies conducted by Eric et al. (2018), and Üredi & Üredi (2006). This study also demonstrated a significant difference in science teaching self-efficacy beliefs with respect to students' year of study. This result is congruent with previous findings (Morgil, Seçken, & Yücel, 2004; Üredi & Üredi, 2006) but cf. Akbaş & Çelikkaleli, 2006; Altunçekiç, Yaman & Koray, 2005; Duban & Gökçakan, 2012; Joseph, 2003; Yaman, Cansüngü, & Altunçekiç, 2004). Moreover, a statistically significant difference was found in PSTs' personal science teaching efficacy beliefs but not found in their science teaching outcome expectations based on the year of study variable. Similar to this study, Duban and Gökçakan (2012) found that self-efficacy beliefs were significantly different between 1st and 3rd year students. This finding of the current research is not congruent with the results of the research conducted by Akbaş and Çelikkaleli (2006) that found a significant difference in student teachers' science teaching outcome expectancy but not in personal science teaching efficacy beliefs according to year of study. Generally, it can be concluded that majority of PSTs held higher beliefs in science teaching self-efficacy. This finding implies that PSTs can effectively teach science lessons, which further results in an increase in student success.

This research suggested that PSTs generally subscribed to a constructivist teaching-learning approach. This result is consistent with the results of previous research (Aypay, 2011; Baş, 2014; Bıkmaz 2011, 2017; Cheng et al., 2007; Oğuz, 2011; Şahin & Yılmaz, 2011). This result might be considered as a result of the current Turkish science curriculum which is based on constructivist learning approach (MoNE, 2013, 2018). Teachers are expected to adopt constructivist the teaching-learning approach rather than the traditional teaching-learning approach and guide pupils accordingly. But in research conducted by Chang and Eliot (2004), it was concluded that student teachers did not adopt any of the constructivist or traditional understanding significantly. In other research carried out by Yeşilyurt (2013), it was found that learning environments in which student teachers were taught did not have the features of the constructivist learning approach and that there were accordingly serious deficiencies in their own applications of these methods. In this research, a statistically significant difference in PSTs' constructivist teaching-learning approach was found by gender in that female PSTs adopted constructivist teaching-learning approach more than males. This finding is consistent with the result of the research conducted by Aypay (2011); however, it differs from the result of the research conducted by Baş (2014) and Oğuz (2011) who found that teachers' constructivist teaching-learning conceptions were not significantly different based on gender. The current study also revealed significant differences in PSTs' traditional teaching-learning conceptions by gender with female PSTs adopting the traditional (teacher-centred) approach more than the males. This result differs from the result of Aypay (2011) and Oğuz (2011) who found that male student teachers held a more traditional teaching-learning approach than the females. One reason of why male student teachers held a more traditional teaching-learning approach than females might be related to their previous educational experiences and the characteristics of the socio-cultural environment in which they live. In this study, PSTs' teaching-learning conceptions were also found significantly different with respect to year of study. This study further revealed significant differences between 1st and 3rd graders and between 3rd and 4th graders in terms of PSTs' teaching-learning conceptions.

Moreover, a positive relationship was detected between PSTs' attitudes towards science teaching and science teaching self-efficacy beliefs. This finding is similar to other studies in the related literature (Berkant & Ekinci, 2007; Çelikkaleli & Akbaş, 2007; Denizoğlu, 2008; Özkan et al., 2002). A positive moderate correlation was also found between science teaching self-efficacy beliefs and a stated preference for the constructivist teaching-learning approach in this study. This finding implies that PSTs who believe that they can teach science lessons effectively were likely to opt for the constructivist teaching-learning approach. Similarly, a research conducted by Ocak et al. (2017) determined a positive relationship between teachers' self-efficacy beliefs and constructivist teaching-learning preferences. Individuals with a high level of self-efficacy belief in science teaching prefer

modern teaching-learning models or strategies congruent with the constructivist approach (Baş, 2014; Ecevit & Kaptan, 2019; Ilgaz, Bülbül & Çuhadar, 2013). Scharmann and Orth Hampton (1995) emphasised that using constructivist teaching-learning approach in the education of student teachers results in an increase in the self-efficacy beliefs in science education. A positive relationship between the PSTs' attitudes towards science teaching and their self-efficacy beliefs was also determined in this research. That is, as science teaching self-efficacy beliefs increase, positive attitudes toward science teaching also increase. In another words, as science teaching self-efficacy belief levels decrease, negative attitudes towards science teaching may occur.

Recommendations

Self-efficacy beliefs are very important for student teachers to become effective practising teachers in the future. Many studies have been conducted focusing on teacher self-efficacy which is a significant factor that effectively contributes to qualified science teaching (Enochs & Riggs, 1990; Fadhila, Ridlo & Rini Indriyanti, 2020). Student teachers, which will be teachers of the future, should be encouraged to develop positive attitudes toward science teaching and high self-efficacy beliefs in order to perform qualified and effective science teaching. Student teachers having high level of science teaching self-efficacy beliefs are likely to prefer student-centred teaching methods/techniques/strategies and will thereby hopefully teach more effective and productive lessons in the future (Appleton & Kindt, 2002; Kozcu Cakir, 2020).

Turkey's science curriculum since 2013 has been based on learner-centred inquiry-based science learning (MoNE, 2013, 2018). Therefore, student teachers should adopt student-centred learning-teaching approaches rather than teacher-centred traditional teaching-learning approaches. In this context, the undergraduate pre-service teacher education programmes should be designed in such a way as to contribute to the development of student teachers in this direction. It is of great importance that undergraduate lessons are carried out in an interactive way with a constructivist approach. Thus, a generation of teachers who grow up with a social constructivist approach can be acquired. While student teachers' self-efficacy beliefs in science education are expected to increase with their year of study, a significant difference could not be found across grade level in this research. Teacher training courses should focus explicitly on developing science teaching self-efficacy beliefs. More importance should be given to the content knowledge courses and teaching practice in order to develop attitudes toward science teaching and self-efficacy beliefs in teacher education programmes. Consistent with this view, NRC (1996) states the following:

... pre-service and in-service training should include experiences that add teachers active learning to their teaching practice and develop their knowledge, understanding and skills. If the teachers themselves have not experienced this at all, it would be probably impossible to convey the vision of the science defined in the standards to the students in schools. (p. 56)

Therefore, courses given in undergraduate education programmes should accordingly include learning experiences that student teachers can experience by themselves in order to contribute to the development of student teachers' knowledge, skills, and affective learning areas (Driver, Leach, Millar, & Scott, 2000).

Limitations

This study has a number of limitations. First, only quantitative methodology was adopted in the present research. In further research, mixed-methodology is recommended to be used to better understand the relations of PSTs' teaching-learning conceptions, attitudes and self-efficiency beliefs toward science teaching through the use of qualitative research methods. Analysis of relationships between the variables through structural equation modelling is also suggested. In the current study,

the sample was selected conveniently and relatively small. Therefore, a similar study is suggested to be conducted with a larger and more representative sample.

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