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The Effect of Research Evidence-based Teaching Practices in Science Classrooms on Student Teachers' Attitudes towards Educational Research

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ABSTRACT Research in the field of education plays a pivotal role in developing evidence-based practices in teaching and improving the quality of education. However, research conducted in recent years has highlighted the unwillingness of teachers to benefit from scientific studies. This study set out to assess whether Research Evidence-Based Practices in Science Teaching (EBPST) influences the teaching practices of student teachers and their attitudes towards education research. Mixed methods research design was used in this study. The study was conducted through Quasi-experimental methods and focus group interviews. The data were collected with the "Teachers Attitude Scale towards Educational Research (TASTER)" and focus group interviews. Participants of the study included 106 third-year undergraduate student teachers. The experimental group applied EBPST during their teaching, while the control group applied existing traditional teaching at primary schools. The Quantitative findings showed that student teachers in the experimental group had significantly increased positive attitudes towards educational research when compared with student teachers in the control group. In addition, qualitative findings revealed that several factors negatively and positively influence the understanding and use of educational research for student teachers on the applicability of EBPST. Considering the results of this study, student teachers' EBPST effect on improving their attitudes, understanding, and the use of educational research in teaching.

Keywords Attitudes, educational research, evidence-based practices, student-teacher, science education

1. INTRODUCTION

1.1 Theoretical Framework of the Research

Research in the field of education plays a pivotal role in developing evidence-based practices in teaching and improving the quality of education. According to McMillan and Schumacher (2010), educational research covers three main areas: (i) basic/fundamental research, which focuses on creating knowledge on various scientific topics; (ii) applied research which aims to identify and develop solutions to the common problems in a scientific area, and (iii) evaluation research which assesses the effectiveness of existing practices. Scientific studies are conducted using systematic methods. Indeed, objectivity, precision, reproducibility, adoption of the most parsimonious explanation, empiricism, logical reasoning, and evidence-based conclusions are all qualities that place scientific studies in educational research in a vital position (McMillan & Schumacher, 2010). This is why information gained from scientific studies is invaluable. Many studies have concentrated on developing the qualities of teachers (e.g., Borko, Liston & Whitcomb, 2007; Ilhan, Sozbilir, Sekerci, & Yildirim, 2015a; Lin, Wang, Klecka, Odell, & Spalding, 2010). A growing number of studies also aimed to identify and develop primary and secondary school pupils (Sozbilir, Kutu & Yasar, 2012).

In improving the quality of education, it is essential that teachers' knowledge and understanding of scientific studies and their ability to follow and apply. The importance of research evidence in teaching practices is revealed by educational researches (Cakmakci et al., 2011; Davies, 1999; Millar, Leach, Osborne, & Ratcliffe, 2006).

At the same time, research in recent years has highlighted the unwillingness of teachers for following and benefitting from studies (Costa, Marques, & Kempa, 2000; De Jong, 2004; Ekiz, 2006; Greenwood & Maheadly, 2001; Yildirim, Ilhan, Sekerci, & Sozbilir, 2014). Indeed, although the number of studies in science education has increased considerably in recent years (Chang, Chang & Tseng, 2010; Sozbilir et al., 2012), the adoption of the findings of such studies in teaching practice is sub-optimal (Biesta, 2007; Everton, Galton, & Pell, 2002; Everett, Luera & Otto,

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2008; Hemsley-Brown & Sharp, 2003; Kempa, 2002; Vanderlinde & van Braak, 2010). These differential findings highlight the gap between science education research and existing teaching practices. Researchers tend to generate research findings (Hemsley-Brown & Sharp, 2003), while the uptake of research findings in teaching practice is inadequate (Yildirim et al., 2014). Kempa (2002) pointed out the discrepancy between research topics and teachers' interests where he argued that existing research revolved around topics that are not seen as a high priority by teachers. In their study addressing the gap between research, theory, and practice, Walter and Hen (2012) concluded that research skills could be best developed and implemented among trainee teachers. De Jong (2004) further elaborated on the gap between science education research and teaching practice and its reason. When Yildirim et al. (2014) studied the extent to which science teachers follow, understand, and use educational research in their teaching, they found that very few teachers regularly follow educational research, and those who do have difficulty in understanding and applying it.

1.2 Attitudes towards Educational Research

Lysenko, Abrami, Bernard, Dagenais, & Janosz (2014) explained that practitioners' (i.e., teachers, administrators, and school professionals) attitudes towards educational research range from mild optimism about research use to skepticism, to even outright cynicism. Teachers tend to develop a more significant positive attitude towards educational research when such research matches their personal experience (Zeuli, 1994) or can be applied in their teaching (Ratcliffe et al., 2005; Shkedi, 1998).

Research on science teachers' classroom practices has shown a relationship between teachers' beliefs about teaching and learning and their teaching practice (Hutner & Markman, 2016; Roehrig, Kruse, & Kern, 2007). Moreover, it can be said that teacher's beliefs are often built relative to other mental constructs, such as knowledge, dispositions, or attitudes. Thus, teachers' beliefs play an essential role in developing classroom practices (Enderle et al., 2014; Haney & McArthur, 2002; Haney, Lumpe, Czerniak, & Egan, 2002; Miranda & Damico, 2013).

Beliefs around the ineffectiveness of educational research in addressing existing educational challenges (Yildirim et al., 2014) often result in negative attitudes towards such research. In addition, existing attitudes towards educational research may further shape teachers' attitudes towards educational research and may lead to positive or negative behaviors (Ilhan, Sekerci, Sozbilir, & Yildirim, 2013). Therefore, it is essential to study the determinants of teachers' attitudes towards educational research. Although several studies are focusing on the attitudes of student teachers, teachers, and educators towards scientific research (Cousins & Walker, 2000; Korkmaz, Sahin, & Yesil, 2011; Papanastasiou, 2005; Walker, 2010), few studies focus on existing attitudes towards educational research (Everton et al., 2002; Ilhan et al., 2015a; Ilhan, Yilmaz, & Dede, 2015b; Ozturk, 2011). In these studies, teachers' attitudes towards educational research were mainly examined qualitatively (Dagenais et al., 2012; Ekiz, 2006; Shkedi, 1998; Vanderlinde & van Braak, 2010). Moreover, studies exploring how teachers can benefit from information generated in scientific studies are limited (Dagenais et al., 2012).

1.3 EBPST

Implementing EBPST is potentially beneficial for the student, education systems, and teachers. However, all of the practical activities that teachers will be benefit from are more clearly found in the theses. In a study conducted by Ilhan et al. (2015a), the results indicate that the least sources of information used by science teachers for education are "educational symposiums, conferences and workshops" and "educational, scientific journals and dissertations." Thanks to the advancement of today's communication technologies, it can be said that teachers' / prospective teachers' opportunities to follow and use educational researches/resources are much easier than in previous decades. For this, first of all, their attitudes towards educational research should be high.

Several studies have indicated that it has been followed and used secondary resources more than primary resources having evidence-based findings (Scientific information, thesis, and scientific articles, etc.) by student teachers or teachers (Kiemer & Kollar, 2021; Ilhan et al., 2015a; Yildirim et al., 2014). In the educational context, evidence-based practice can be defined as considering scientific findings for professional instructional practices (such as instructional strategy, teaching, and learning techniques) (Foster, 2014). In the educational literature, different terms are used instead of evidence-based education, such as evidence-based practice, evidence-informed practice, or evidence-based teaching (e.g., Biesta, 2007; Dunn, Saville, Baker, & Marek, 2013; Nelson & Campbell, 2017). To provide future teachers with empirically supported evidence-based teaching and the appropriate skills to use that evidence, they must acquire the necessary skills. Also, it is important to teach skills for using evidence-based practice in teaching (Diery, Vogel, Knogler, & Seidel, 2020).

Teachers are often criticized for not adopting the research-based practice in classrooms (McIntyre, 2005). However, utilizing and benefitting from scientific research in both science education and teaching is vital for the career development of teachers. Studies assessing the extent to which science teachers follow, understand, and adopt educational research in their trainee years are limited. Moreover, the strategies for increasing teacher interest in educational research are highly understudied. Such studies would be invaluable for developing the ability of student teachers to provide evidence-based practice in science teaching and improve the current attitudes of student

Table 1 Research design

Groups	Pretest	Intervention	Posttest
Experimental (n=58)	TASTER	EBPST	TASTER Focus Group Interview (n=12)
Control (n=48)	TASTER	Traditional (existing curriculum)	TASTER

TASTER: Teacher Attitude Scale towards Educational Research
EBPST: Evidence-Based Practices in Science Teaching

Table 2 Internal consistency of TASTER

	Experimental		Control	
	Pre-test	Post-test	Pre-test	Post-test
Cronbach's Alpha	.829	.825	.88	.88

teachers towards research. The findings of this study are essential for this reason.

This study set out to assess whether Evidence-Based Practices in Science Teaching (EBPST) influences the teaching practices of student teachers and their attitudes towards education research. In particular, the study sought the find answers to the following questions:

(1) What is the effect of the EBPST and traditional teaching (current program) made by student teachers on their attitudes towards education research?

(2) How does EBPST influence the student teachers' attitude to and their ability to understand and use educational research?

2. METHOD

In order to investigate how EBPST influences the teaching practices of student teachers and their attitudes towards education research, we used a combination of quantitative and qualitative methods. In order to compare the effect of EBPST on improving student teachers' attitudes towards education research, the teaching intervention (experimental and control groups) were assigned. Mixed methods research design, which combines qualitative and quantitative methods (Creswell, 2015), was used in this study. The quantitative part of the study involved a quasi-experimental, pretest-posttest design with a non-random sample (Table 1). Two groups, namely, experimental and control groups, were set for the study. The student teachers in the experimental group were instructed to adhere to Evidence-Based Practices in Science Teaching (EBPST), while the control group adhered to existing traditional teaching methods (existing curriculum). In addition, the Teachers' Attitude Scale towards Educational Research (TASTER) was administered to the student teachers before and after the intervention. The qualitative part of this study involved focus group interviews with student teachers in the experimental group. Each focus group consisted of six randomly selected student teachers and aimed to discover student teachers' opinions about the EBPST. The focus group interviews have enabled the identification of detailed findings (McMillan & Schumacher, 2010). Thus, the findings of qualitative and quantitative parts of this research were complementary.

2.1 Study Participants

Participants in this study included 106 third-year undergraduate students (student teachers) from the department of elementary education in a state university in Kilis, Turkey. The details of study participants in the research design are provided in Table 1. Forty-eight teacher students were assigned to the control group, and fifty-eight teacher students were assigned to the experimental group. Before this study was performed, students had signed up for the same sections for an elementary science teaching class. Therefore, the individuals were randomly assigned to groups (Fraenkel & Wallen, 2011). Twelve students in the experimental group were then randomly selected for the focus group interviews.

Further, the student teachers had undertaken relevant courses such as 'scientific research methods' and 'science and technology teaching' in the previous period of intervention for this study.

2.2 Data Collection Tools

Teachers Attitude Scale towards Educational Research (TASTER)

In this study, the TASTER was used in order to determine the attitudes towards educational research. The validity and reliability studies of TASTER were presented in previous studies that used survey methods (Ilhan et al., 2013; Ilhan et al., 2015b; Sekerci, Ilhan, Sozbilir, & Yildirim, 2017). TASTER with 20 items was developed into three components. Construct validity of three-factor TASTER was determined by exploratory and confirmatory factor analysis. Components of TASTER are necessity (item; 1,3,7,10,14,17,20), value (item; 2,6,9,11,12,16) and applicability (item; 4,5,8,13,15,18,19).

Each item in TASTER includes a five-point Likert scale ranging from totally disagree (1) to completely agree (5). The internal consistency of TASTER for this study was determined using Cronbach's Alpha. Chronbach's Alpha for the experimental and control groups ranged between .825 and .88 (Table 2). These values indicate a high internal consistency for the scale (McMillan & Schumacher, 2010, p.188).

Focus Group Interviews

After the teaching interventions were completed, focus group interviews were conducted with a sub-sample of student teachers in the experimental group. Two focus groups of six randomly selected student teachers were formed. Each focus group interview lasted approximately 60 minutes. The study researcher carried out interviews, and the data were collected through digital video

Table 3 Teaching intervention

	Experimental Group	Control Group
Number of student teachers	48	58
Number of groups	8	10
Number of mentor teachers	8	10
Number of researchers as mentors	8	10
Primary school grade	Grades 4-5	Grades 4-5
Time and location	The student teacher did three weeks of observation in their primary school (4 hours per week). The student teacher did three weeks of EBPST in primary school (4 hours per week) Three-hour sessions by researcher and mentor (1 hour per week)	The student teacher did three weeks of observation in primary school (4 hours per week). The student teacher did three weeks of traditional teaching in primary school (4 hours per week). Three-hour sessions by researcher and mentor (1 hour per week).
Materials and Lesson plans	Preparing lesson plans using the EBPST template created through prior theses or articles. Creating classroom activities using the "EBPST template" created through prior theses or articles. Opportunities for group discussions and feedback from mentor and researcher.	Preparing lesson plans created through textbooks in the existing programs. Creating classroom activities using textbooks in the "existing programs." Opportunities for group discussions and feedback from mentor and researcher.
Applied Teaching/Learning methods	The teaching methods used by student teachers differed according to the master or dissertation thesis for EBPST. The thesis used by student teachers for teaching methods; mind map and concept cartoon activities in science education (Balim, 2010), 5E teaching models (Ozsevgec, 2007), laboratory approach (Maras, 2008), theory of multiple intelligences (Gök-Altun, 2006), cooperative learning (Olgun, 2011), project-based learning (Sert-Cıbık, 2006), problem-based learning (Tandoğan, 2006), context-based teaching, argumentation theory-based teaching (Sagır, 2008), analogy (Karadoğu, 2007).	Teaching methods according to the existing curriculum were used. These included 5E teaching models or teacher-centered teaching models (i.e., taking notes, solving problems, etc.).
Lesson topics	1. Let's solve the puzzle of our bodies; 3. Force and movement; 5. The Earth, the sun, and the moon; 7. Light and sound	2. States and definition of matter; 4. Electricity in our lives; 6. Let's explore the living world;

recordings. Five questions were determined for the focus group interviews under the guidance of two academic staff members who have previously published in the field. During the interviews, the researcher probed the questions to the group, and when one student responded, the interviewer (researcher) enquired whether the other students agreed with the provided answer. The interviewer adopted roles such as 'uninformed facilitator,' 'arbitrator facilitator,' and 'therapist facilitator' to encourage open and honest answers from student teachers (Bas & Akturan, 2008). The student teachers shared their experiences during the interviews, which lead to identifying similarities and differences in experiences. In this way, the attitudes towards educational research as well as their determinants were delineated.

The following questions were used in focus group interviews:

- Could you explain how you implemented the educational research materials (e.g., dissertation, journal articles, etc.) in your classroom activities?
- How were your attitudes towards educational research affected after adopting Evidence-Based Practices in Science Teaching (EBPST) in the classroom?
- What do you think about the need for educational research?
- What do you think about the value of educational research?
- What are your opinions on the applicability of educational research in teaching?

2.3 Data Analysis

This study involved the analysis of qualitative and quantitative data. The quantitative data collected through the TASTER was analyzed using the SPSS statistical software. The data obtained from TASTER was initially analyzed descriptively and then parametric tests. First, the differences in pretest-TASTER scores of groups were evaluated by using an independent sample t-test. Then, the differences in posttest-TASTER scores of groups were evaluated using covariance analysis (ANCOVA) (Miles, Huberman, & Saldaña, 2014; McMillan & Schumacher, 2010). In the ANCOVA, differences between the groups on the pretest are covariate, then adjusted post-test scores of groups are compared.

Data collected through focus group interviews were analyzed as qualitative. The focus group interviews collected through digital video recordings were transcript

Table 4 Means for each item

TASTER	Experimental		Control	
	Pre	Post	Pre	Post
1-Educational research provides beneficial information that I can use in lectures.	4.45	4.71	4.25	4.19
2-Scientific publications regarding education (dissertations, articles, books, etc.) contribute to an increase in the quality of education.	4.14	4.74	4.25	4.13
3-I am pleased to teach according to the findings of the educational research.	3.67	4.36	*3.35*	*3.65*
4-Educational research conducted by academics is carried out only to enhance their careers.*	3.14	4.02	*3.23*	*3.29*
5-If I teach lessons according to data obtained from educational research, the topics cannot be completed*.	3.22	3.72	*2.98*	*3.04*
6-Teachers should benefit from the findings of educational research.	4.26	4.66	4.38	4.23
7-I like to attend seminars on educational research.	3.74	3.98	*3.35*	*3.48*
8-I believe that the scientific publications regarding education (dissertations, articles, books, etc.) are superficial.*	3.67	4.19	*3.21*	*3.35*
9-It is necessary to benefit from educational research to become a qualified teacher.	4.34	4.52	4.31	4.17
10-Educational research contributes to the development and renewal of the educational curriculum.	4.36	4.55	*4.35*	*4.04*
11-It is necessary to conduct scientific research in education.	4.38	4.60	4.46	4.23
12-It is important to be informed about educational research.	4.43	4.50	4.27	4.27
13-It is a waste of time to teach lessons according to the results of the educational research.*	3.93	4.26	3.63	3.46
14-Educational research generates solutions for the problems I encounter in teaching.	3.91	4.17	*3.71*	*3.77*
15-I do not think the findings of educational research are applicable in teaching practice.*	3.34	4.07	3.46	3.23
16-Educational research contributes to the development of the teaching profession.	4.41	4.55	4.27	3.98
17-The findings of educational research that are recounted in seminars are beneficial.	4.12	4.29	3.96	3.96
18-Educational research does not have applicability in the school environment.*	3.83	4.33	3.65	3.54
19-Teaching lessons according to the findings of educational research reduces student success.*	4.02	4.53	3.88	4.00
20-The findings of educational research are important for me in selecting teaching models, methods, and techniques according to the topic in the teaching process.	4.29	4.48	4.10	3.90

**Negative items*

and saved in Word format. Content analysis was used to analyze the data (McMillan & Schumacher, 2010). As the constituent of the research question, questions in focus group interviews, and theoretical component, it was employed qualitative content analysis. A combination of inductive and deductive coding (Miles, Huberman, & Saldaña, 2014) to analyze questions in a focus group interview to answer the second research question. Each of the three researchers coded the data then categories were formulated. Two researchers coded and categorized the focus group interviews independently. After comparing and discussing, the author combined discrepancies of codes and categories and then reviewed the process and the finding to ensure internal validity (Merriam, 2009). In reporting qualitative results, quotations from data were used to illustrate the code and categories (e.g., ST1, ST2, etc., for student teachers).

2.4 Teaching Intervention

The student teachers in the experimental and control groups conducted teaching sessions in fourth-grade science classes at primary schools in Turkey. The experimental group applied EBPST during their teaching, and the control group students adhered to the existing traditional teaching methods. The primary schools in which the study took place were selected randomly and were assumed to have the same level of education.

The details of the teaching intervention are provided in Table 3. Both the experimental and control group student teachers were assigned into groups of six. The student teachers in each group attended the same school. These groups were formed with particular attention to group heterogeneity and the desires of the student teachers. All groups were composed of six student teachers, except for two groups in the control group made up of five student teachers. A mentor, who was a current teacher in each primary school, was assigned for each group. The researchers and mentors met with the student teachers to provide them with information regarding the methods they need to use in class. Student teachers in the control group prepared lesson plans and activities created through textbooks in the existing program (MNE, 2013). The experimental group prepared lesson plans and activities using the template created through prior master or dissertation thesis for EBPST. Using these instead of articles is that the thesis covers all of the application activities for teaching. Student teachers applied educational research into practice in science classes in primary school. The thesis used by the experimental group contains teaching activities in science education about mind map and concept cartoon (Balim, 2010), 5E teaching models (Ozsevgec, 2007), laboratory approach (Maras, 2008), theory of multiple intelligences (Gök-Altun, 2006),

Table 5 Independent samples t-test for pretest-TASTER scores

Groups	N	Mean	SD	t	p
Experimental	58	3.98	0.40	-1.483	0.141
Control	48	3.85	0.50		

SD: Standard Deviation

Table 6 Descriptive statistics for posttest-TASTER

Groups	Post-test		
	Mean	SD	Adjusted Means of Post-TASTER After ANCOVA
Experimental	4.36	0.32	4.34
Control	3.79	0.46	3.81

cooperative learning (Olgun, 2011), project-based learning (Sert-Cıbık, 2006), problem-based learning (Tandoğan, 2006), context-based teaching, argumentation theory-based teaching (Sagır, 2008), and analogy (Karadoğu, 2007).

3. RESULTS

3.1 Quantitative Results

The data obtained from TASTER was initially analyzed descriptively. As a result, the mean post-test scores tended to be higher than pretest scores for each item in the TASTER (Table 4). On the other hand, the control group increased the mean scores of items 3, 5, 7, 8, 10, and 14, respectively, while the post-test mean scores for the other items were lowered.

The skewness coefficient of the distribution of the group scores was determined to assess whether or not the parametric tests would be used in the data. Value of the coefficient of skewness of the pretest-TASTER of the control groups, posttest-TASTER of the control groups, pretest-TASTER of the experimental groups, posttest-TASTER of the experimental groups, is respectively -0.386, -1.388, .139, .133. Thus, when these values were examined, the value does not majorly deviate from the normal distribution (Buyukozturk, 2012).

Independent samples t-test for differences in pretest-TASTER scores of groups are conducted (Table 5). The finding showed that pretest-TASTER scores of groups did not differ significantly, $t(114) = -1.483$, $p>.01$.

ANCOVA was used to compare the adjusted mean scores for the posttest-TASTER scores of groups. The mean posttest-TASTER scores for the experimental and control groups were 4.36 and 3.79, respectively (Table 6). When these scores were adjusted based on corresponding pretest-TASTER scores, the mean adjusted post-test scores of the experimental group were higher than that of the control group (M = 4.34 versus M = 3.81). Statistically significant differences were observed for the difference between the adjusted mean posttest-TASTER scores of the experimental and control groups, $F(1, 103) = 52.054$, $p<.01$, $\eta 2 = 0.33$ (Table 7).

3.2 Qualitative Results

The data obtained from interviews were categorized into codes by considering the purpose of the research and the research question. The codes and supporting statements are detailed in Tables 8-9. The codes were combined under four main categories:

- Factors that positively influence the understanding and use of educational research
- Factors that negatively influence the understanding and use of educational research
- Indicators of positive attitudes towards educational research
- Indicators of negative attitudes towards educational research

As detailed in Table 8, the factors which positively influence the understanding and use of educational research revolved around using group work when utilizing scientific knowledge activities, observing the positive impact of research on students, undertaking a research methodology course, and accessing details for activities given in the theses. On the other hand, negative factors for understanding and using educational research included academic jargon and statistics used in the theses, lack of details for activities in studies, lack of time, challenges in finding/accessing resources, the unfamiliarity of students with evidence-based practice, and lack of appropriate school facilities.

As detailed in Table 9, the opinions that were indicators of positive attitudes towards educational research included interest, practice, belief in the applicability of EBPST activities, curiosity, confidence, considering research to be necessary, and following research. These factors increased

Table 7 ANCOVA of posttest-TASTER with pretest score as a covariate

Source	Df	Mean Square	F	Sig.	Partial Eta Squared(η^2)
Corrected Model	2	5.422	40,054	.000	.437
Intercept	1	10.607	78,365	.000	.432
Pretest	1	2.391	17,666	.000	.146
Group (experimental-control)	1	7.046	52,054	.000	.336
Error	103	.135			
Total	106				
Corrected Total	105				

Df: Degree of freedom, R Squared = .437 (Adjusted R Squared = .427)

the positive attitudes of student teachers towards educational research. On the other hand, the opinions that were indicators of developing negative attitudes towards educational research included the limited physical capacity of schools, preconceptions regarding educational research, teaching methods textbooks, students' academic level, environmental factors, and lack of media attention research. These opinions lead to negative attitudes towards educational research.

4. DISCUSSION

This study evaluated whether evidence-based practices in science teaching (EBPST) influence the teaching practices of student teachers and their attitudes towards education research. The findings of this study showed that the design used as an EBPST is better to improve students teachers' positive attitude towards educational research-level compared to the traditional teaching. This finding supports that utilizing student teachers to EBPST helps increase the positive attitudes towards science education research. Furthermore, the pretest and post-test scores for the individual items in TASTER showed an increase in the experimental group scores. In contrast, the control group showed no changes in scores in general. From this, it could be deduced that EBPST improves all items in TASTER.

When Dagenais et al. (2012) reviewed the empirical literature about the use of research-based information by school practitioners, they have found that practitioners' attitudes towards research affected their use of research-based information. Previous research has shown that student teachers' attitudes towards educational research start to be formed during their undergraduate studies (Ilhan et al., 2015b). Moreover, their research skillset is developed during this period (Walter & Hen, 2012), and this skill set does not change substantially after the students become practicing teachers. A reason for this may be that currently, the teachers are not required to use EBPST. However, many studies have argued that teachers do not sufficiently follow educational research, and they also do not adopt scientific research-based methods in their teaching (Shkedi, 1998; Ratcliffe et al., 2005; Dagenais et al., 2012; Yildirim et al., 2014). A possible explanation of this could lie in the lack of positive attitudes towards educational research during undergraduate education. In this regard, scientific

Table 8 The state of understanding and use of educational research by student teachers

Categories	Codes	Sample quotations supporting statement
Factors that positively influence	Working in groups	'Working in groups allows us to understand and to use in the practice of academic theses relatively easily.'*[ST3]*
		'When we worked in groups when one did not understand a point, he would raise it. Another would explain it, and in this way, we complemented each other.' *[ST4]*
	Observing positive effects	'As I observed the differences in students, I realized it is important to understand education research as theses.' *[ST6]*
	Undertaking a research methodology course	'Undertaking a research methodology course enabled us to understand the theses and journal articles easily.' *[ST5]*
	Detailed activities	'In project-based education, students need to report their project through written reports. However, we did not know how to prepare such reports. We were given detailed reports in the thesis. We prepared sample reports and lesson plans based on these.' *[ST2]*
	Family involvement	'Collaboration with families may help teachers save time.' *[ST7]*
	Encouragement/incentives	'If teachers were to be paid extra depending on the success of their students, it would encourage them. They could then prepare better activities.' *[ST8]*
Factors that negatively influence	Academic jargon and statistics	'There is difficulty in understanding the calculations for reliability coefficient. A lot of unknown words are used.' *[ST5]*
		'There are statistics, data analysis, and findings—these are challenging to understand.' *[ST10]*
		'There are difficulties in understanding numerical parts. Survey findings, reliability coefficients, and alike are hard to understand.' *[ST5]*
	Lack of details for activities	'We looked at a thesis, and it only talked about the steps. It said that the students did this and that without much detail. We did not understand what exactly we were supposed to do.' *[ST2]*
	Lack of time	'Preparing activities and arranging them and adapting them to the environment as necessary take much time for teachers.' *[ST5]*
	Unable to identify appropriate studies	'We are unable to find a thesis in this area. We got help from our mentors and found different theses.' *[ST1]*
	Unfamiliarity of students	'Students do not know what to do and how to act in the new system. Students may not be able to do the required prep-work; they may not want to do activities outside class time.' *[ST4]*
	School facilities	'There may be problems with finding sufficient materials in the school labs. The classes may be crowded.' *[ST1]*

Table 9 Student teachers' attitudes towards educational research

Categories	Codes	Sample extracts
Positive attitudes	Application	'To be honest, as I used these applications, the preconceptions I had regarding scientific research and articles were overcome.' *[ST11]*
		'As I started to cover topics in the theses, I started to develop a positive attitude towards theses.' *[ST6]*
		'For example, if I did not use the concept maps and concept cartoons, I would not have believed that the theses are applicable in classrooms.' *[ST5]*
	Belief inapplicability	'It would be better if especially the authors of the textbooks picked lecture activities from the research theses.' *[ST5]*
		'Whenever I thought of scientific research, I thought of abstract academic jargon. However, I came to realize that such activities can be applied in classrooms.' *[ST11]*
		'We had realized that activities in the thesis are applicable when we used them.' *[ST1]*
	Interest	'When we see different things [teaching methods/activities] in the theses, they attract our attention. They also attract student interest.' *[ST1*
	Curiosity	'I really liked the different activities that incited student curiosity for research.' *[ST7]*
		'Research incites curiosity, indeed.' *[ST1]*
	Confidence	'This kind of study helped strengthen my confidence regarding my teaching duties.' *[ST4]*
	Necessity	'There is a need to conduct research and use relevant findings in education as well. I certainly think that research must be conducted for understanding and implementing new programs.' *[ST3]*
	Following research	'New methods are developed for improving and developing students. We need to follow research.' *[ST2]*
		'Now we followed research, but I also had the chance to look at the journal article over the weekend as I was curious about concept-based learning.' *[ST7]*
		'For example, I joined a website so I can use scientific studies in other topics.' *[ST5]*
Negative attitudes	School facilities	'We have difficulties in finding enough materials in laboratories. Classes are crowded; the applications are not appropriate for them.' *[ST10]*
	Preconceptions/bias	'New methods come up every day. It is hard to keep up to date.' *[ST1]*
		'When I read the thesis, I think we cannot apply the same methods.' *[ST9]*
	Teaching methods textbooks	'For example, in the science textbook, the topic was for high school students. In the teaching methods books, sample activities are not appropriate for the level of students.' *[ST1]*
		'The sample activities given in teaching methods books are not appropriate.' *[ST12]*
	Level of students	'Our students are not the same students as those in the theses.' *[ST9]*
	Environmental factors	'There are people whom I met after graduation. They question why we put so much emphasis [on research].' *[ST10]*
	Belief	'There is no emphasis in the press regarding following and using research' *[ST11]*

research focusing on developing strategies to improve attitudes towards educational research is crucial.

In this study, the student teachers discussed their opinions on the applicability of EBPST. According to these opinions, the factors which positively influence attitudes towards understanding educational research and applying EBPST were using group work in developing and planning EBPST, observing the positive effect of such practice on students, undertaking a scientific research methods course, and opportunity to access details of teaching activities provided in the theses. Further, the student teachers who adopted EBPST in their teaching expressed many opinions supporting their interest in educational research. These opinions showed that the factors that improved attitudes towards educational research were personal interest, practicing EBPST, believing in the applicability of such methods, curiosity in EBPST, increased confidence, understanding the necessity of research-based methods, and following educational research. The opinions reported in this study also show how understanding educational research and applying research-based methods could benefit the student teachers themselves. Further, these opinions reflect increases in the positive attitudes of student teachers towards educational research. Existing research in this field has emphasized the importance of action research for understanding the level of understanding and use of educational research in teachers (Kucuk & Cepni, 2005; Walter & Hen, 2012).

In this study, the opinions of student teachers who used EBPST showed that several factors negatively influence the understanding and use of educational research among student teachers. These factors included the academic jargon and statistics used in educational research, lack of reporting of detailed sample activities, lack of time, unavailability of resources, the unfamiliarity of students with EBPST, and limited physical capacity of schools. Similar findings were reported in studies exploring why the lack of following and adopting educational research and related methods among educational practitioners

(Dagenais et al., 2012; De Jong, 2004; Latham, 1993; Shkedi, 1998; Yildirim et al., 2014).

5. CONCLUSION

In this study, mixed methods research design, the student teachers in experimental groups were instructed to adopt EBPST. In contrast, control group student teachers used traditional methods (existing curriculum) in their teaching. Findings were obtained to determine how EBPST influences student teachers' teaching practices and their attitudes towards education research. Data were collected with TASTER and 'Focus Group Interviews.'

The quantitative findings of this study, conducted through Quasi-experimental methods, showed that compared with the control group, the student teachers who utilized EBPST had an increased positive attitude towards educational research. Thus, according to the results of this study, we can say that student teacher' use of EBPST have affected their attitudes towards educational research. Furthermore, the experimental group used activities by arranging the template created through prior master or dissertation thesis for EBPST. In contrast, the control group used activities created through textbooks in the existing program (MNE, 2013).

The qualitative finding of this study, conducted through focus group interviews with student teachers in the experimental group, was obtained their opinions on the applicability of EBPST. The factors which positively influence attitudes towards understanding educational research and applying EBPST were using group work in developing and planning EBPST, observing the positive effect of such practice on students, undertaking a scientific research methods course, and the opportunity to access details of teaching activities provided in the theses. However, student teachers' opinions who used EBPST showed that several factors negatively influence the understanding and use of educational research among student teachers. These factors included the academic jargon and statistics used in educational research, lack of reporting of detailed sample activities, lack of time, unavailability of resources, the unfamiliarity of students with EBPST, and limited physical capacity of schools.

Considering the findings of this study, we recommend the addition of core undergraduate courses that focus on improving attitudes and increasing the understanding and the use of educational research in teaching. In addition, the student teachers' opinions reported in this study could be used to tailor the content of such courses.

6. LIMITATIONS AND RECOMMENDATIONS

The results of this study are limited to elementary student teachers in science teaching, and the student teachers were located in a university and a city. This limits the extent to which these findings can be generalized to different student teachers. Nevertheless, EBPST made by student teachers appears effective for attitude, understand, and using of educational research. Although this is a small-sized study, it does present whether EBPST interventions focused on attitude, understanding, and use of educational research are a worthy research investment. We suggest that future research efforts should enhance how EBPST interventions can be optimized for understanding and using educational research.

REFERENCES

Balim, A. G. (2010). *The effects of mind map and concept cartoon activities in science and technology education on students' academic achievement and inquiry learning skill perceptions* (Unpublished Master's Thesis). Dokuz Eylul University Graduate School of Educational Science, İzmir, Turkey.

Bas, T. & Akturan, U. (2008). *Nitel araştırma yöntemleri NVivo 7.0 ile nitel veri analizi* [Qualitative research methods, qualitative data analysis with Nvivo 7.0]. Ankara: Seçkin Yayıncılık.

Biesta, G. (2007). Bridging the gap between educational research and educational practice: The need for critical distance. *Educational Research and Evaluation*, *13*(3), 295-301. http://dx.doi.org/10.1080/13803610701640227

Borko, H., Liston, D., & Whitcomb, J.A. (2007). Genres of empirical research in teacher education. *Journal of Teacher Education*, *58*(1), 3-11. http://dx.doi.org/10.1177/0022487106296220

Buyukozturk, S. (2012). *Sosyal bilimler için veri analizi el kitabı* [Data analysis for the social sciences handbook]. Ankara: Pegem A Yayıncılık.

Cakmakci, G., Tosun, O., Turgut, S., Orenler, S., Sengul K. & Top, G. (2011). Promoting an inclusive image of scientists among students: towards research evidence-based practice. *International Journal of Science and Mathematics Education*, *9*(3), 627-655. http://dx.doi.org/10.1007/s10763-010-9217-4

Chang, Y. H., Chang, C. Y., & Tseng, Y. H. (2010). Trends of science education research: An automatic content analysis. *Journal of Science Education and Technology*, (4), 315–331. http://dx.doi.org/10.1007/s10956-009-9202-2

Costa, N., Marques, L., & Kempa, R. (2000). Science teachers' awareness of findings from education research. *Research in Science and Technological Education*, *18*(1), 37-44. http://dx.doi.org/10.1080/713694955

Cousins, J. B., & Walker, C. A. (2000). Predictors of educators' valuing of systemic inquiry in schools. *Canadian Journal of Program Evaluation (Special Issue)*, 25–53.

Creswell, J.W. (2015). *A concise introduction to mixed methods research*. Thousand Oaks, CA: Sage.

Dagenais, C., Lysenko, L., Abrami, P. C., Bernard, R. M., Ramde, J., & Janosz, M. (2012). Use of research-based information by school practitioners and determinants of use: a review of empirical research. *Evidence & Policy: A Journal of Research, Debate and Practice*, *8*(3), 285-309. http://dx.doi.org/10.1332/174426412X654031

Davies, P. (1999). What is evidence-based education?. *British Journal of Educational Studies*, *47*(2), 108–121.

De Jong, O. (2004). Mind your step: Bridging the research-practice gap. *Australian Journal of Education in Chemistry*, *64*, 5-9.

Diery, A., Vogel, F., Knogler, M, & Seidel, T. (2020). Evidence-based practice in higher education: Teacher educators' attitudes, challenges, and uses. *Frontiers in Education, 5*(62), 1-13. https://doi.org/10.3389/feduc.2020.00062

Dunn, D. S., Saville, B. K., Baker, S. C., & Marek, P. (2013). Evidence-based teaching: Tools and techniques that promote learning in the psychology classroom. *Australian Journal of Psychology*, *65*(1), 5–13. https://doi.org/10.1111/ajpy.12004

Ekiz, D. (2006). Primary school teachers' attitudes towards educational research. *Educational Sciences: Theory & Practice*, *6* (2), 373-402.

Enderle, P., Dentzau, M., Roesler, K., Southerland, S., Granger, E., Hughes, R.,… Saka, Y. (2014). Examining the influence of RETs

on science teacher beliefs and practice. *Science Education*, *98*, 1077–1108.

Everett, S. A., Luera, G. R., & Otto, C. A. (2008). Pre-service elementary teachers bridge the gap between research and practice. *International Journal of Science and Mathematics Education*, *6*(1), 1-17. http://dx.doi.org/10.1007/s10763-006-9063-6

Everton, T., Galton, M., & Pell, T. (2002). Educational research and the teacher. *Research Papers in Education*, *17*(4), 373-401. http://dx.doi.org/10.1080/0267152022000031388

Foster, R. (2014). Barriers and enablers to evidence-based practices. *Kairaranga*, *15*(1), 50-58.

Fraenkel, J.R., Wallen, & Hyun, (2011). *How to design and evaluate research in education*. New York: McGraw-Hill Humanities/Social Sciences/Languages.

Gök-Altun, D. (2006). *Effect of sound and light unit prepared using multiple intelligence theory to the student success, level of retaining, attitudes towards science and multiple intelligence theory* (Unpublished Master's Thesis). Muğla University Institute of Science, Muğla, Turkey.

Greenwood, C. R., & Maheadly, L. (2001). Are future teachers aware of the gap between research and practice, and what should they know?. *Teacher Education and Special Education*, (4), 333-347. http://dx.doi.org/10.1177/088840640102400407.

Haney, J. J., & McArthur, J. (2002). Four case studies of prospective science teachers' beliefs concerning constructivist teaching practices. Science Education, 86, 783–802.

Haney, J. J., Lumpe, A. T., Czerniak, C. M., & Egan, V. (2002). From beliefs to actions: The beliefs and actions of teachers implementing change. *Journal of Science Teacher Education*, *13*, 171–187.

Hemsley-Brown, J., & Sharp, C. (2003). The use of research to improve professional practice: A systematic review of the literature. *Oxford Review of Education*, *29*(4), 449-471. http://dx.doi.org/10.1080/0305498032000153025.

Hutner, T. L., & Markman, A. B. (2016). Proposing an operational definition of science teacher beliefs. *Journal of Science Teacher Education*, *27*(6), 675-691. http://dx.doi.org/10.1007/s10972-016-9480-5

Ilhan, N., Sekerci A. R., Sozbilir, M., & Yildirim, A. (2013). The development of teachers attitude scale towards educational research: the validity and reliability study. *Western Anatolia Journal of Educations Sciences*, *4*(8), 31-56.

Ilhan, N., Sozbilir, M. Sekerci, A. R., & Yildirim, A. (2015a). Turkish science teachers' use of educational research and resources. *Eurasia Journal of Mathematics, Science & Technology Education*, *11*(6), 1231-1248. http://dx.doi.org/10.12973/eurasia.2015.1374a

Ilhan, N., Yilmaz, Z. A., & Dede, H. (2015b). Attitudes of pre-service science teachers towards educational research and their science teaching efficacy beliefs in Turkey. *Journal of Baltic Science Education, 14*(2), 183-193.

Karadoğu, Z. (2007). *The effect of using analogy in primary school science and technology lesson on success and attitude* (Unpublished Master's Thesis). Yuzuncu Yil University Graduate School of Social Science, Van, Turkey.

Kempa, R. (2002). Research and research utilization in chemical education. *Chemistry Education: Research and Practice in Europe*, (3), 327-343.

Kiemer, K., & Kollar, I. (2021). Source selection and source use as a basis for evidence informed teaching: Do student teachers' beliefs regarding the utility of (non-)scientific information sources matter?. *Zeitschrift für Pädagogische Psychologie*, *35*(2-3), 1-15. https://doi.org/10.1024/1010-0652/a000302

Korkmaz, O., Sahin, A., & Yesil, R. (2011). Candidate teachers' attitude toward scientific research. *International Online Journal of Educational Sciences*, *3*(3), 1169-1194.

Kuçuk, M., & Cepni, S. (2005). Implementation of an action research course program for science teachers: A case for Turkey. *The Qualitative Report*, *10*(2), 190-207.

Latham, G. (1993). Do educators use the literature of the profession?. *National Association of Secondary School Principals Bulletin*, *77*(550), 63–70.

Lin, E., Wang, J., Klecka, C.L., Odell, S.J., & Spalding, E. (2010). Judging research in teacher education. *Journal of Teacher Education*, *61*(4), 295-301. http://dx.doi.org/10.1177/0022487110374013

Lysenko, L. V., Abrami, P. C., Bernard, R. M., Dagenais, C., & Janosz, M. (2014). Educational research in educational practice: predictors of use. *Canadian Journal of Education/Revue canadienne de l'éducation*, *37*(2), 1-26.

Maras, T. (2008). *İlköğretim 4. sinif fen ve teknoloji dersi iskelet ve kas sistemi konusunun laboratuar yöntemi ile işlenmesinin öğrenci başarisina etkisi* [The effect of teaching the subject of skeletal and muscular system in primary school 4th grade science and technology course with laboratory method on student success] (Unpublished Master's Thesis). Gazi University Graduate School of Educational Science, Ankara, Turkey.

McIntyre, D. (2005). Bridging the gap between research and practice. *Cambridge Journal of Education*, *35*(3), 357-382. http://dx.doi.org/10.1080/03057640500319065

Mcmillan, J. H., & Schumacher, S. (2010). *Research in education: evidence-based inquiry* (7th edition). New York: Pearson Publishing.

Merriam, S. B. (2009). *Qualitative research: A guide to design and implementation*. San Francisco, CA: JosseyBass.

Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis: A methods sourcebook* (3rd ed.). London: Sage.

Millar, R., Leach, J., Osborne, J., & Ratcliffe, M. (Eds.). (2006). *Improving subject teaching: Lessons from research in science education*. London: Routledge.

Miranda, R. M., & Damico, J. B. (2013). Science teachers' beliefs about the influence of their summer research experiences on their pedagogical practices. *Journal of Science Teacher Education*, *24*, 1241–1261. http://dx.doi.org/10.1007/s10972-012-9331-y

MNE (Ministry of National Education), (2013). *Primary education institutions (elementary and junior high schools) science program*. Ankara, Turkey.

Nelson, J., & Campbell, C. (2017). Evidence-informed practice in education: Meanings and applications. *Educational Research*, *59*(2), 127-135. https://doi.org/10.1080/00131881.2017.1314115

Olgun, M. (2011). *The effect of cooperative learning method including self and peer assessment applications on student's success, attitude and metacognitive skills in primary 4th grade science and technology lesson* (Unpublished Master's Thesis). Dokuz Eylul University Graduate School of Educational Science, İzmir, Turkey.

Ozsevgec, T. (2007). *Determining effectiveness of guided materials about "force and motion" unit based on the 5e model for elementary students* (Unpublished Doctoral Dissertation). Karadeniz Technical University Graduate School of Science, Trabzon, Turkey.

Ozturk, M. A. (2011). Confirmatory factor analysis of the educators' attitudes toward educational research scale. *Educational Sciences: Theory and Practice*, *11*(2), 737-748.

Papanastasiou, E. C. (2005). Assessing the factor structure of a questionnaire that measures student's attitudes towards research. *Statistics Education Research Journal*, *4*(1): 16–26.

Ratcliffe, M., Bartholomew, H., Hames, V., Hind, A., Leach, J., Millar, R., & Osborne, J. (2005). Evidence-based practice in science education: The researcher–user interface. *Research Papers in Education*, *20*, 169–186. http://dx.doi.org/10.1080/02671520500078036

Roehrig, G. H., Kruse, R. A., & Kern, A. (2007). Teacher and school characteristics and their influence on curriculum implementation. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, *44*(7), 883-907.

Sagır, S. U. (2008). *Investigation of effectiveness of argumentation theory based teaching in science courses* (Unpublished Doctoral Dissertation). Gazi University Graduate School of Educational Science, Ankara, Turkey.

Sekerci, A. R., Ilhan, N., Sozbilir, M., & Yildirim, A. (2017). Science and technology teachers' attitudes towards educational research in Turkey. *Asia-Pacific Forum on Science Learning & Teaching*, *18*(1), 1-21.

Sert-Cıbık, A. (2006). *The effect of project based learning approach to the logical thinking ability and attitude of students in science lesson* (Unpublished Master's Thesis). Cukurova University Graduate School of Social Science, Adana, Turkey.

Shkedi, A. (1998). Teachers' attitudes towards research: A challenge for qualitative researchers. *International Journal of Qualitative Studies in Education*, *11*, 559-577. http://dx.doi.org/10.1080/095183998236467

Sozbilir, M., Kutu, H., & Yasar, M. D. (2012). Science education research in Turkey: A content analysis of selected features of papers published. In D. Jorde ve J. Dillon (Eds). *Science Education Research and Practice in Europe: Retrospective and Prospective* (pp.341-374). Rotterdam: Sense Publishers.

Tandoğan, R. O. (2006). *The effects of problem based active learning on the student's academic achievement and learning concepts on science education* (Unpublished Master's Thesis). Marmara University Graduate School of Educational Science, İstanbul, Turkey.

Vanderlinde, R., & van Braak, J. (2010). The gap between educational research and practice: Views of teachers, school leaders, intermediaries and researchers. *British Educational Research Journal*, *36*(2), 299-316. http://dx.doi.org/10.1080/01411920902919257.

Walker, D. A. (2010). A confirmatory factor analysis of the attitudes toward research scale. *Multiple linear regression viewpoints*, *36*(1), 18-27.

Walter, O., & Hen, M. (2012). Bridging the gap between research and practice in teachers' preparation. *Universal Journal of Education and General Studies*, *1*(7), 216-224.

Yildirim, A., Ilhan, N., Sekerci, A. R., & Sozbilir, M. (2014). Science teachers' level of following, understanding and using of educational researches: the example of Erzurum and Erzincan. *Kastamonu Education Journal*, *22*(1), 81-100.

Zeuli, J. (1994). How do teachers understand research when they read it?. *Teaching and Teacher Education*, *10*, 39–56. http://dx.doi.org/10.1016/0742-051X(94)90039