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Effects of Video-Supported Expertise-Based Training (XBT) on Preservice Science Teachers' Self-Efficacy Beliefs

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This study investigated the effects of expertise-based training (XBT) supported with videos including expert teachers' shared experiences in a real class environment on preservice science teachers' science teaching self-efficacy, in addition to their perceptions on the effects of XBT. The participants were 32 preservice science teachers registered for Methods of Teaching Science I. The methodology of the study was concurrent triangulation mixed methods research design. The data were collected through the Science Teaching Efficacy Belief Instrument (STEBI), open-ended questionnaires following experts' videos, observations, and interviews. During analysis, a paired t-test wasconducted for quantitative data, and open coding analysis was applied for qualitative data. The quantitative results showed that after the intervention, science teaching efficacy beliefs increased. Moreover, the qualitative data showed that preservice science teachers learned a great deal about the application of teaching methods.

Keywords: expertise-based traning, XBT, teaching efficacy, science education, beliefs

INTRODUCTION

Teacher education programs aim to provide pre-service teachers expertise in teaching. According to Darling-Hammond (2000), expertise in teaching is one of the most significant factors affecting students' success, and teachers who are fully certified are more successful than their peers. Korthagen, Loughran, and Russell (2006) oppose this view, pointing to the assumption that expertise can only be gained by experience and university courses only provide a theoretical base of learning principles. They stated, "This view creates many difficulties, including the fact that the 'expertise' of teaching practice is often assumed to reside largely in schools with teachers. This view diminishes the rich possibilities that can be made available at the university site" (Korthagen et al., 2006, p. 1029). The findings of Yılmaz and Huyugüzel Çavaş (2008) support the the importance of teacher education programs. They concluded that experiences in undergraduate courses affect pre-service elementary teachers' self-efficacy and classroom management beliefs. However, Stepich and Ertmer (2009) criticized teacher education programs because they focus on theoretical background rather than real-life problem solving. Ertmer, Conklin, and Lewandowski (2001) suggested that educators should offer more teaching experiences for pre-service teachers. Yilmaz-Tuzun and Ozgelen (2012) further addressed the importance of micro teaching experiences for prospective teachers in real class environments.

Gaining expertise in teaching may also enhance pre-service teachers' self efficacies. Dembo and Gibson (1985) stated that teachers' self-efficacy beliefs affect their performances during teaching. Self-efficacy has been described by Bandura (1997) as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 3). Two factors affect perceived self-efficacy: context and the results of the actions performed (Bandura, 1997).

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State of the literature

- Most of the literature emphasizes the gap between theoretical knowledge and practice in teaching. Gaining expertise in teaching narrows this gap.
- One instructional design theory that can be applied to provide increased development for preservice teachers is expertise- based training (XBT).
- XBT is based on the idea that theories and findings of expert research can be used to create instructional strategies to enhance advanced learners' expertise. Technology can benefit the presentation of these new methods.

Contribution of this paper to the literature

- This study is an example of how to use technology to present experts' methods and strategies related to teaching in a real classroom.
- The current literature presents a consensus about decreased self-efficacy beliefs during classroom teaching. This study provides a method to bring real classroom experiences to teacher education courses.
- The literature reviewed on expertise in teaching and its effects on preservice teachers' self-efficacy beliefs was mostly theoretical articles. However, this study presents actual evidence of the effects of expertise in teaching on preservice teachers' self-efficacy beliefs.

According to Gibson and Dembo (1984), if teachers believe that, effective teaching can influence students' learning (outcome expectancy beliefs) and they can teach well (self-efficacy beliefs), they will likely foster academic achievement in the classroom and provide different types of feedback. Zengin's (2003) study showed that the teacher with higher self-efficacy prepare better instructions and place more importance on students' success and development than teachers with low self-efficacy. Hoy and Spero's (2005) longitudinal study showed that pre-service teachers' self-efficacy beliefs increased during university education but decreased significantly during their first year teaching. Moreover, Sancar Tokmak, and Karakus (2011) showed that Information Communication Technology (ICT) teachers had difficulty applying different teaching strategies in the classroom since they had not faced many identified situations. Expertise-based training (XBT) is an instructional design proposed by Fadde (2009) based on the idea that demonstrating expert experiences to novices may help novices be aware of new situations.

In this study, the researcher aimed to investigate the effects of video-supported XBT on preservice science teachers' (PST) self-efficacy beliefs. Therefore, the PSTs' self-efficacy beliefs were first assesssed. Then, videos showing expert science teachers in real classrooms were presented, after which the instructor facilitated discussion. The PSTs selected topics from the science and technology course program, and then they prepared and presented micro teachings in class using contemporary methods. At the end of the semester, preservice science teachers' self-efficacy beliefs were assessed again.

Theoretical Base of the Study: Expertise-Based Training (XBT)

XBT is an instructional design theory designed to develop advanced learners' skills by creating instructional strategies and is applicable to all fields (Fadde, 2010). Fadde (2009) suggests using the theories, findings, and methods of expert research in order to create instructional strategies. Ward, Suss, and Basevitch (2009) have observed that expertise has been studied in fields ranging from law enforcement to nursing to education. In each field, instructional strategies can be drawn from the relevant literature, and XBT can be applied. For example, Fadde (2010) developed strategies from expert-novice research paradigm, and used videos in order to train sporters about sport-specific perceptual cognitive skills. He presented where experts look for picking up predictive information through videos (Fadde, 2010).

Fadde and Klein (2010) state professionals such as teachers can gain expertise through extensive job experience. They suggest providing opportunity on four exercises (estimation, experimentation, extrapolation, and explanation) for advanced learners (Fadde & Klein, 2010). Fadde and Klein (2010) emphasize the importance of the awareness of resources, and time needed to complete a task; learning from the results the action; having lessons from others' actions; and concluding a result for reflective explanation.

XBT was incorporated in a research study designed by Sancar Tokmak and Incikabi (2012) for developing mathematics education preservice teachers' expertise with educational software evaluation and selection. In their study, they compared the XBT and control groups' software evaluation and selection scores in relation to the experts. The instructional strategies applied in their studies were drawn from a study conducted by Sancar Tokmak, Incikabi, and Yanpar Yelken (2012). They presented case examples of expert software evaluation procedures with classroom discussions to the XBT group and found that the XBT group used approaches more similar to and scored more closely with the experts when compared to the control group (Sancar Tokmak & Incikabi, 2012). Ertmer et al. (2009) developed hard scaffolding guidelines for novices to help them solve problems related to instructional design, which proved beneficial. On the other hand, Ifenthaler (2009) applied three types of feedback models (cutaway, discrepancy, and expert) based on expert representation about climate change and generated randomly by a concept map program, HIMATT. The results showed that indirect presentation of expert modeling did not help participants solve problems correctly, and Ifenthaler (2009) concluded that mental model building and performances of experts may be more beneficial if they were presented in a direct way, such as through simulation environments.

XBT theories and research guided the researcher to design the instructional strategies of the current study. The research studies, investigated the effect of XBT on the teachers'/preservice teachers' teaching efficacies, were not found in the reviewed literature. The researcher used videos of expert science teachers in real classrooms, featuring different teaching strategies. The PSTs watched the videos and discussed key points. Then, the PSTs taught science with micro teaching assignments.

Research Questions

In line with the aim of the research study, the following research questions were investigated:

- *Is there a significant difference between the preservice science teachers' science teaching self-efficacy beliefs before and after XBT instruction?*
- *What are the preservice science teachers' perceptions about XBT instruction effects on teaching efficacy?*
- *Which strategies from the experts' videos were applied by the preservice science teachers?*

METHODOLOGY

The methodology of the study was concurrent triangulation (convergence model) mixed methods design. According to Creswell and Plano Clark (2007), the convergence model includes collecting and analyzing quantitative and qualitative data separately in order to compare and contrast results during interpretation: "Researchers used this model when they want to compare results or validate, confirm, and corroborate quantitative results with qualitative findings" (p. 65). In the current study, quantitative research included an experimental group of pre-test/post-test design, supported with qualitative data collected through open-ended questionnaires, observations, experts' videos, and interviews. The researcher's intent was to examine the effect of expertise-based training (XBT) supported with videos of expert teachers in a real class environment on PSTs' science teaching self-efficacy beliefs. Moreover, PSTs' perceptions on the effect of XBT to improve science teaching self-efficacy beliefs were aimed to be invastigated in the study. Quantitative and qualitative data were collected concurrently. In other words, while the researcher applied XBT instruction and observed the effects of this intervention, data was collected to investigate participants' perceptions on such effects as well as teaching strategies.

Participants and Context of the Study

This study was carried out during Methods of Teaching Sciences I with the help of the course instructor, who has been working as academician at the Elementary Science Education department for 4 years, at a public university in Turkey. This course is offered in the spring semester for third year PSTs. The course was redesigned to provide meaningful and practical experiences in XBT instruction and to help PSTs gain deeper understanding of teaching science. The design promoted active involvement in teaching science with micro teaching assignments.

During the spring semester, this course was offered in two sections; this study was conducted with 32 volunteer PSTs, who formed the study section. Every week, PSTs met for four hours in class or a science laboratory during the semester. All PSTs were juniors and had science major backgrounds. The PSTs completed science coursework in biology, chemistry, physics, and mathematics during their first two years of the elementary science teacher education program. Of the 32 PSTs, 19 were female, while 13 were male. The mean age was 21.8 years, ranging from 20 to 27 years.

Procedure of the Study

The study took place during the spring semester of 2012. At the beginning of the semester, the demographics questionnaire and STEBI were applied. First, theory was provided with the support of expert videos in a classroom environment where the PSTs discussed the teaching methods presented. After each of the three videos, the PSTs answered open-ended questionnaires. The course continued with teaching practice. The PSTs were divided into 12 groups with 2 or 3 members each, and these groups selected subject matters to teach. At the end of the semester, the STEBI was conducted again; one month after the semester ended, interviews were conducted by the researcher. Figure 1 shows the procedure and instruments of the study. As seen from the Figure 1, the quantitative and qualitative data were collected concurrently.

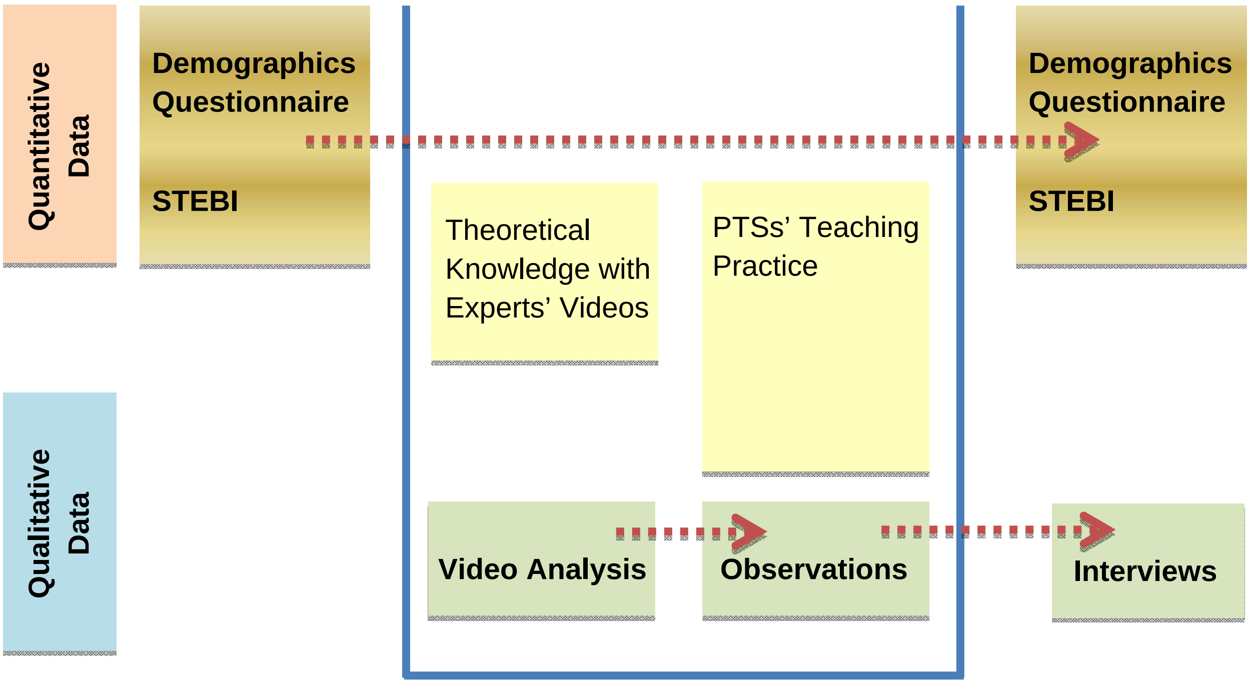

Figure 1. The course design and procedure of the study

XBT Strategies Applied

XBT strategies applied in the study included two main parts: Presentation of videos including expert science teachers' teaching in a classroom environment, and the PSTs' micro-teaching assignments. In the first part, the PSTs' watched expert science teachers' videos including different teaching strategies/methods in real classroom environment. The videos were selected in line with some criteria: 1) Subject matter taught in video should be from secondary school science curriculum. 2) It should include expert science teachers' teaching in real classroom. 3) It should include teaching strategies/methods suggested by national curriculum. For each video, the PSTs' answered the open-ended questionnaire, and then discussed the teaching sessions conducted by expert science teachers. During the presentation of videos including the experts' teaching, the PSTs were aimed to be aware of time, resource use, classroom management strategies, and teaching strategy/method application.

In the second part, the PSTs taught their friends. According to the XBT, job experiences are the one of the key points while providing expertise. During teaching practice, it was aimed to the PSTs' reflecting and practicing what they were aware about teaching strategies/methods of the experts in videos.

Data Sources

The data were collected through the Science Teaching Efficacy Belief Instrument (STEBI), open-ended questionnaires, videos, observations and interviews. Field notes were taken by the researcher of the article. Moreover, four instruments were conducted to collect data during the study:

Demographics questionnaire: The researcher developed the questionnaire under an expert's guidance. The questions asked about age, gender, major, GPA, educational courses completed, and types of activities conducted in these course(s).

Science Teaching Efficacy Belief Instrument (STEBI): The STEBI was developed by Riggs and Enochs (1990) and translated into Turkish by Özkan, Tekkaya ve Çakıroğlu (2002) to investigate PSTs' science teaching efficacy beliefs. This instrument, which is a 5-type Likert type (5 = strongly agree, 4 = agree, 3 = uncertain, 2 = disagree, and 1 = strongly disagree), includes two dimensions: personal science teaching efficacy belief (PSTEB) and science teaching outcome expectancy (STOE). The PSTEB subscale consists of 13 items, eight negatively worded and five positively worded, and the STOE subscale consists of ten items, eight positively worded and two negatively worded items. The minimum and maximum scores for PSTE range from 13 (13 x 1) to 65 (13 x 5); STOE scores can range from 10 (10 x 1) to 50 (10 x 5). The possible scores for STEBI range from 23 (23 x 1) to 115 (23 x 5). Riggs and Enochs (1990) listed the alpha coefficient as 0.76 for the PSTE scale and 0. 90 for the STOE scale. Özkan, Tekkaya, and Çakıroğlu (2002) conducted a validity-reliability analysis for the Turkish version of the STEBI and found an alpha coefficient of 0.79 for the PSTE scale and an alpha coefficient of 0.86 for STOE. Moreover, Denizoğlu (2008) reanalyzed the instrument in terms of validity and reliability. She found an alpha coefficient of 0.85 for the STEBI, an alpha coefficient of 0.84 for the PMTE scale, and an alpha coefficient of 0.78 for the STOE scale.

Open-ended questionnaire: This instrument was developed by the researcher and checked by an expert. It was conducted after each expert video to collect data about the teaching strategies that the PSTs focused on.

The questionnaire included four questions:

- *Which teaching strategy was used by the expert teacher?*
- *What are the steps of applied teaching strategy by the expert teacher?*
- *What do you think about the teaching strategy applied?*
- *What alternative teaching strategies might be applied?*

Interview Form: The last instrument was a semi-structured interview at the end of the semester. The PSTs answered six questions prepared by the researcher and checked by an expert:

- *Could you please mention the knowledge you gained during Methods of Teaching Sciences supported with videos?*
- *To what extent do the videos and micro-teaching affect your knowledge?*
- *Did the videos including expert teaching sessions affect your teaching practice? If yes, could you explain in detail?*
- *Which activities in the course did you like most? Please mention the reasons.*
- *Could you please mention the difficulties you met during preparation for teaching practice?*
- *Could you please mention the difficulties you met during teaching sessions?*

Data Analysis

The demographics data was analyzed through descriptive statistics. Qualitative data were collected through interviews, observations, and open-ended questionnaires and analyzed independently by the researcher and a colleague using open coding analysis. The inter-coder reliability was found to be 0.93 according to Miles and Huberman's (1994). The data collected through STEBI before and after the intervention to examine the PSTs' self-efficacy beliefs changed, and a paired t-test was conducted. The STEBI instrument had two sub-scales: Personal Science Teaching Efficacy (PSTE) and Science Teaching Outcome Expectancy (STOE). For that reason, the data analyses were conducted first for the PSTs' science teaching self-efficacy beliefs for each sub-scale, then for STEBI as a whole. SPSS 14.0 was used to present the inferential statistics. Moreover, the effect size was calculated to extract the practical significance of the statistical testing through the eta squared categorization as "0.01 = small effect, 0.06 = moderate effect and 0.14 = large effect" (Cohen, 1988, p. 22).

Validity - Reliability Issues

As both quantitative and qualitative data were collected, validity and reliability strategies of both approaches were used: triangulation, peer review, and external audit (expert opinion). The open-ended questionnaires, observations, interviews, and expert video analysis were used to triangulate results. The analyses were completed by the researcher and a colleague, and inter-coder reliability was found as 0.93, in line with Miles and Huberman's (1994) formula. Moreover, expert opinion was solicited during instrument development, data analysis, and interpretation to eliminate researcher bias.

The validity and reliability threats and coping strategies offered by Fraenkel and Wallen (2000) were taken as reference during quantitative data collection, including mortality, location, data collector characteristics, data collector bias, statistical regression, and implementation. Mortality was not a threat in the study because there was not any data loose. Location was not a problem, since the place where the data were collected and the procedures were applied remained constant. The instructor was also consistent throughout. Therefore, data collector characteristics and implementation were not a threat. Moreover, the consistent procedures and instruments avoided data collector bias. The threat of statistical regression threat was also eliminated since participants were not chosen on a basis such as score.

Ethical issues

Ethical issues were taken into account during the study. The PSTs were volunteers, but since they were also students in the course, they were assigned pseudonyms during the study to promote freedom of expression. Moreover, interviews were conducted one month after the semester ended.

RESULTS

Research Question 1: Inferential Statistics for PSTs' Science Teaching Efficacy Beliefs Based on XBT Instruction

The Science Teaching Efficacy Belief Instrument (STEBI) was used in this study. During quantitative data analysis, two steps were followed. The first step, data cleaning, was conducted to examine missing cases and outliers using descriptive statistics (mean, percentage, frequency, and SD). After manipulating extreme cases and missing information, the data set was subjected to analysis to calculate Cronbach's alpha reliability coefficient. In the second step, an inferential statistic paired t-test was performed. The STEBI has two

Table 1. The descriptive statistics for pre and post STEBI scores

STEBI	Mean	Minimum	Maximum	*SD*	*N*
Pre- STEBI	52.37	39.00	63.00	6.33	32
Post- STEBI	55.84	45.00	84.00	7.09	32

Table 2. Paired-sample t-test results

STEBI	Pre- Mean	Post- Mean	*t*	*df*	Effect Size
Total STEBI	52.37	55.84	3.63*	31	.17
Total PSTE	27.03	29.96	4.07*	31	.21
Total STOE	25.34	25.87	1.25	31	----

*p<.001

dimensions, Personal Science Teaching Efficacy (PSTE) and Science Teaching Outcome Expectancy (STOE). To determine which dimensions of science teaching efficacy beliefs improved as a result of expertise-based training intervention, a targeted paired t-test was conducted. The mean value of pre-test science teaching efficacy beliefs was 52.37 with a standard deviation of 6.33, while the mean value of the post-test beliefs was 55.84 with a standard deviation 7.09 (Table 1). According to results of the paired sample t-test, there was a statistically significant increase from pre-test STEBI (M = 52.37, SD = 6.33) to post-test STEBI (M = 55.84, SD = 7.09), $t(32) = 3.63$, $p < .001$.

A paired samples t-test was also performed to investigate differences between science teaching efficacy beliefs scores on the two dimensions of STEBI. Table 2 shows the results.

As shown in Table 2, statistically significant differences emerged between pre- and post-test scores of PSTs' Personal Science Teaching Efficacy (PSTE). However, there was no statistically significant difference between pre and post-test scores of PSTs' Science Teaching Outcome Expectancy (STOE). To determine whether the differences in the two dimensions were likely to occur by chance, effect size values were considered. One of the most commonly used effect size statistics is eta squared using the following guidelines; .01 = small effect, .06 = moderate effect, .14 = large effect (Cohen, 1988). Therefore, the eta squared statistic for total-STEBI (.17) and total PSTE (.21) indicated an effect size large enough to warrant practical significances for the differences determined.

Research Question 2: The PSTs' Perceptions of XBT Instruction on Teaching Efficacy

The analysis of the interviews supported statistical results in that PSTs stated that they learned many things about teaching practices because of the videos and activities. Moreover, the PSTs stated that they found their second teaching practice sessions more successful. The interview results were categorized by codes that emerged during data analysis: constructivist approach, importance of teaching practice, difficulty in teaching practice, methods used during science teaching, effects of videos on teaching practice, and the most beneficial parts. Table 3 shows the categories and subcategories.

According to the interview analysis, the PSTs learned the theoretical base of teaching strategies via a constructivist approach and appreciated the opportunity to practice that theoretical knowledge by teaching in class. According to participants, teacher education courses should be designed to include substantial teaching practice, particularly in real classrooms. PSTs suggested placing more importance on School Experience courses, in which preservice teachers visit schools to observe experienced teachers' classroom teaching and to teach students. The PSTs pointed out that the most beneficial part of the course was the teaching practice, as they learned many things about teaching strategies. Also, they stated that they learned from their friends' critiques about their teaching as well as from watching their friends. PST5 explained:

> *I realized the mistakes that friends made during their teaching practice. I tried to not make the same mistakes. I started to think about my instruction. Moreover, I realized how I could improve my instruction thanks to friends' comments. Of course, there was a difference between my first and second teaching practice… In my opinion, the first one was awful. The second one was more student-centered. You could see a difference in my friends' behaviors, as well.*

According to interview analysis, participants had several difficulties micro teaching in the classroom, including deciding the topic, planning activities, researching teaching methods and strategies, and classroom and time management, with the last being most challenging. PSTs felt that despite learning the theoretical background of teaching strategies, applying them was complex. Moreover, they pointed out that they were novices and could not immediately decide what they should do in problematic situations. The PSTs suggested that teacher education programs should provide more teaching practice and school experience courses. The interview analysis results also showed that due to the videos, PSTs were more aware of potential

Table 3. The codes emerged according to interview result analysis

Codes emerged of interview analysis

- Constructivist approach
- Importance of teaching practice
  - in real classroom
  - in courses
    - More than one time
- most beneficial part
  - teaching practice
    - learning by teaching
    - learning from friends
      - learning from friends' teaching experience
      - learning form friends' critics
- Difficulty during teaching practice
  - difficulties met
    - selection of topic taught
    - planning activities
    - searching about teaching methods applied
    - classroom management
    - time management
  - Reasons
    - Difference between theory and practice
    - Not being expert in teaching
    - Time limitation
  - Solutions for problems
    - Providing opportunity for teaching practice
    - "school experience" courses
- Effects of videos on teaching practice
  - Realizing application of teaching methods in real classroom
    - Difficulties met
    - Time management during teaching
    - Classroom management
    - The manners asked questions
  - Changing in ideas about Constructivist approach application
    - More difficult to apply

difficulties, time management strategies, and the asking of questions in class. PST1 explained:

> *I had not thought about real classroom applications of the learned teaching strategies before the videos. I can guess what I will meet during real class now, but I cannot say anything about my success in real classroom teaching sessions since I need to teach there first.*

Some PSTs stated that their opinions about constructivist teaching strategies changed during the course as they realized how difficult it was to guide students while watching the videos and during their teaching sessions. PST1 indicated:

Before this course, constructivism had been very easy for me. However, during the course, my ideas changed. Really, it was very difficult to design activities and guide students to help them construct knowledge.

Research Question 3: Strategies of the Video Experts Used by the PSTs

The interviews, open-ended questionnaires, and observation notes were analyzed to examine which expert teaching strategies were used. According to interview results, the PSTs benefited mostly from time management, classroom management, and question asking strategies. Analysis of the open-ended questionnaires administered after the experts' videos showed that PSTs mostly focused on designing activities, overcoming difficulties, and tackling strategies. The codes that emerged from the results of the open-ended questionnaire were teaching strategies applied, dynamics of classroom applications, difficulties met, tackling strategies, and alternative teaching strategies.

Table 4. Groups, subject matters they taught, and the teaching strategies they used

Groups	Subject Matters	The Teaching Strategies Used
Group 1	Light and sound	*Problem based learning*
Group 6	Digestive system	
Group 2	Pressure in Liquids and Solids	
Group 8	Features and classification of alive and inanimate beings	*Learning through Discovery*
Group 3	States of matter (solid, liquid, gas)	*Learning through Station technique*
Group 4	Solution	
Group 11	Plant and animal cells	*Learning through Experiments*
Group 5	Solid waste (batteries)	*Project based Learning*
Group 7	Earth and Solar System	
Group 12	Classification of substance	*Cooperative Learning*
Group 9	Skeletal system	*Inquiry based Learning*
Group 10	Photosynthesis	*Learning through Drama*

The PSTs stated that the teaching strategies applied in the videos included project-based, learning through experiments, and cooperative learning. They felt that all of the teaching strategies followed a student-centered approach. For that reason, they pointed out that in the videos, the dynamics of the classroom consisted of interaction between students, interaction between instructors and students, teacher guidance, and student effort. They emphasized that in the videos, the teachers skillfully directed the process while not interrupting student–student interaction. In the open ended questionnaire, PST10 stated:

The instructions on the video were student centered. The students were presenting their projects. During the instruction, the preservice science teachers should observe, analyze, synthesize, and apply to create a project. The teacher guided the presentation of project well.

According to the open ended questionnaires, the difficulties observed in the videos mostly related to managing the process. The PSTs explained how the experts asked questions to prompt understanding of the mechanisms. Moreover, to encourage students to focus on important parts of instruction, the expert teachers facilitated discussion and applied specific activities.

PST18: During the experiment, the teacher managed the process well, I think. It is very difficult to do experiments. She wanted the students to try another one and lastly, waited them reach a chemistry equation. The students were in groups, and they made noise, but the teachers made them focus on the experiments by reminding them of their purpose, determining a chemistry equation. I think that this instruction is very difficult to manage, especially in terms of classroom management and time limitations.

The PSTs presented a consensus on the applied teaching strategies' effectiveness, according to the open ended questionnaires. They preferred the same teaching strategy as the experts and did not point out any alternative methods.

The observation notes showed that the groups used different teaching strategies based on constructivist learning theory during their teaching practice in class. The three expert science teachers' videos included three approaches—project based learning, cooperative learning, and learning through experiments—and the observation analysis considered whether the groups used the experts' strategies, and, if so, which ones (See Table 4).

The codes that emerged according to the observation results were defined by the names of the strategies applied during practice sessions (Appendix A). All PST groups tried to apply a student-centered approach while teaching topics similar to the experts' videos. Moreover, both PSTs and experts provided students an environment to discuss the topic, observe peers, conduct experiments, and reflect on their inferences about results. Like the experts, the PSTs asked students questions during their sessions. The results showed that the groups who applied problem-based or inquiry-based learning had difficulty teaching according to the idea behind these strategies. The group who applied problem based learning only asked questions for the students to consider. The inquiry-based learning group defined a group of students who searched for the topic, instead of all students. Observation notes on one group indicated:

Group 4: (Learning through Experiments): The topic was solutions. The class was divided into three groups. The experiment equipment was provided to each group. This equipment was: oil, water, alcohol, and beaker. Then, all groups were given salt, iron powder, and wood dust. Then, the groups were asked to mix these materials with liquid and investigate the other groups' results. During investigation, they were requested to complete a table. Each group came together and discussed the results with friends while filling out the tables provided to them. Then, one member from each group wrote their conclusions about the experiments on the blackboard. The three groups' *conclusions were discussed by the class. At the end of the lesson, a worksheet was given to the classroom, and all the members answered it individually.*

Shortly, the STEB instrument showed that after XBT intervention, the PSTs' science teaching efficacy beliefs increased. Moreover, the qualitative data supported to the quantitave data in that the PSTs stated they applied the strategies observed in the expert science teachers' videos. Moreover, they explained that they learned a great deal about the application of teaching methods.

DISCUSSION AND IMPLICATION

Expertise is a goal for every profession. Teacher education programs aim to provide expertise for preservice teachers, since students' success depends on their teaching. XBT is one instructional design theory that can be used to provide experiences that enhance skills (Fadde, 2009). In the current study, XBT instruction supported by videos of expert science teachers was designed for PSTs. Moreover, expertise may increase self-efficacy. The aim of this study was to investigate the effects of XBT on PSTs' self-efficacy and their perception about these effects. For that purpose, the PSTs watched three videos demonstrating expert science teachers' classrooms. Then, they taught a subject from the national science curriculum. A convergent model of mixed methods research design was applied to collect data. Before and after instruction, the STEBI was administered to 32 PSTs. During instruction, videos, open-ended questionnaires, observations while the PSTs were teaching, and interviews took place. The quantitative data collected through STEBI was analyzed through paired samples t-test. The qualitative data were analyzed through open coding analysis.

The results showed a significance difference between the PSTs' science teaching efficacy beliefs before and after the XBT instruction. Similarly, Bong (1999) found that expert students had less generality of self-efficacy beliefs than novices. She claims, "Presumably, as one gains more knowledge and expertise in the domain, one begins to make more accurate assessments of task demands and characteristics, which, in turn, lead to clearer distinctions between one's subjective competencies" (Bong, 1999, p. 329). The current study results may be interpreted to indicate that as PSTs gain expertise in teaching, their beliefs about teaching effectively and their teaching efficacy beliefs increase.

Moreover, according to the results, the PSTs' STOE were not significantly changed after the XBT training. Based on the qualitative data, the PSTs believed that the videos helped in terms of making them aware of classroom application of teaching strategies, but they could not pass judgment without teaching in a real classroom. It can be said that the PSTs' STOE may change after they teach in real classroom. Similarly, Hoy and Spero's (2005) study showed that real classroom teaching changed the teaching self-efficacy beliefs of PSTs.

The qualitative results of the study also showed that the PSTs used the strategies demonstrated by the expert videos; both the PSTs and experts designed classroom environments where students could observe, conduct experiments, and reflect on results. This result may be interpreted as the improvement in PSTs' science teaching self-efficacy beliefs were stemmed from XBT. Similarly, Ertmer et al. (2009) found that the effect of providing hard scaffolding guidelines for novices helps them become experts and solve problems related to instructional design. Moreover, Sancar Tokmak, and Incikabi's (2012) study showed that an XBT instruction group of mathematics education PSTs had educational computer software evaluation processes more similar to the experts when compared to the control group.

The findings of study have many implications for understanding the factors of enhancing science teaching efficacy beliefs through instructional design with the help of technology. During the current study, the PSTs had opportunity to observe, experience, reflect and explain what they realized in the videos of the expert science teachers. Moreover, they could have change to apply what they realized during their micro-teaching. Pajares (1996) stated that to have more confident students, researchers should investigate factors affecting self-efficacy beliefs. The same is true for researchers who study teacher education. This study showed that expertise is one factor that may affect PSTs' science teaching self-efficacy beliefs. Moreover, XBT instruction supported with different technologies can be used to provide PSTs experience teaching and to observe more expert-like behaviors. In other words, XBT may help preservice teachers be more confident teaching. However, it should be emphasized that certain judgments cannot be made because of the sampling limitation and lack of control group for the study. Further research is needed to investigate how the results of this study would differ if the pre-test/post-test design were applied to larger numbers of preservice teacher participation.

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APPENDIX A. The Codes Emerged according to Analysis of Observation Notes and Expert Video Analysis

Codes emerged from analysis of observation notes	Codes emerged of Expert video analysis
• Discovery Learning o Doing science experiments o Students' making inferences by observing experiment results o Students' observing natural events ▪ Making inferences about observation results o Creation together ▪ Table about topic ▪ Concept map	
• Learning through experiments o Making students' remember pre-knowledge o Making students do experiments ▪ Filling the table as a results of experiments o Discussing the results o Doing experiments ▪ Dividing class into groups ▪ Making students draw pictures about experiments results	• Learning through experiments o *Doing experiments* o *Dividing class into groups* o *Making students observe experiment* o *Making students discuss experiment results*
• Problem based learning o Giving a problem o Dividing students into groups o Making students do experiments o Asking questions	
• Cooperative learning o Dividing students into groups o Making students search about different sides of topic ▪ Preparing posters ▪ Presenting the classroom	• Cooperative learning o *Dividing students into groups* o *Making students search about different sides of topic* o *Presenting the classroom*
• Project based learning o Diving students into groups o Making students develop projects about the topic o Making students present their projects o Asking questions during presentations	• Project based learning o *Diving students into groups* o *Making students develop projects about the topic* o *Making students present their projects* o *Asking questions during presentations*
• Learning through station technique o Dividing the class into three groups o Making class create a story about topic ▪ Making first group create story ▪ Making second group complete story ▪ Making third group complete story o Doing experiments o Creating a table about topic	
• Inquiry based learning o Forming an expert group in the class o Making experts search about the topic o Sharing the knowledge in class o Creating concept maps	
• Drama o Giving a role in each student o Making students search the role requirements o Making students dramatize the roles o Asking questions about their roles	
• Student centered	• Student centered