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Investigation of Pre-Service Teachers' Beliefs about Addressing Science Process Skills Using Theory of Planned Behavior

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Abstract: This study intended to specify salient beliefs of pre-service primary school teachers (PPSTs) in terms of addressing science process skills (SPS) in their future science teaching. For this purpose, Ajzen's (1991) Theory of Planned Behavior was used as a theoretical framework. Twelve Turkish junior PPSTs completed a questionnaire comprised of open-ended questions, which was followed by one-to-one interviews. According to content analysis results, PPSTs believed that including SPS in science teaching results in largely positive consequences, such as allowing students to learn knowledge permanently and enabling students to use these skills in daily life. The only negative consequence of implementing SPS in science teaching articulated by PPSTs was that the time left for science subjects would be short. Parents and school administrators emerged as the most prominent normative referents related to using SPS in science teaching. Lastly, a number of control factors that would ease or obstruct PPSTs' implementation of SPS during science teaching were specified, such as availability of laboratory equipment and materials at school, large class size, and support from school administrators. Recommendations were made in order for PPSTs to address SPS in their future science teaching.

Keywords: science Process Skills, Science Teaching, Theory of Planned Behavior, Pre-Service Primary School Teachers, Content Analysis

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Öğretmen Adaylarının Bilimsel Süreç Becerilerine Yer Verme ile ilgili İnançlarının Planlanmış Davranış Teorisi Kullanarak Araştırılması

Özet: Bu çalışma sınıf öğretmeni adaylarının, gelecekteki fen öğretimlerinde bilimsel süreç becerilerine (BSB) yer verme ile ilgili inançlarını belirlemeyi amaçlamıştır. Bu amaçla, Ajzen'in (1991) Planlanmış Davranış Teorisi, kuramsal çerçeve olarak kullanılmıştır. Üçüncü sınıfa giden on iki Türk sınıf öğretmeni adayı, açık uçlu sorulardan oluşan bir anket doldurmuş, arkasından bu öğretmen adayları ile birebir görüşmeler yapılmıştır. İçerik analizi sonuçlarına göre öğretmen adayları, fen öğretimine BSB'yi dahil etmenin, öğrencilerin bilgiyi kalıcı olarak öğrenmelerini ve bu becerileri günlük yaşamda kullanmalarını sağlamak gibi çoğunlukla olumlu sonuçları

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olduğuna inanmaktadır. Fen öğretiminde BSB'yi uygulamanın öğretmen adayları tarafından ifade edilen tek olumsuz sonucu fen konuları için kalan zamanın az olacağıdır. Ebeveynler ve okul yöneticileri, fen öğretiminde BSB'yi kullanmaya ilişkin en belirgin normatif referanslar olarak ortaya çıkmıştır. Son olarak, öğretmen adaylarının fen öğretimi sırasında BSB'nin uygulanmasını kolaylaştıracak veya zorlaştıracak bir dizi kontrol faktörü belirlenmiştir; okulda laboratuvar araç-gereç ve malzemelerinin bulunması, sınıf mevcudunun kalabalık olması ve okul yöneticilerinin desteği gibi. Öğretmen adaylarının gelecekteki fen öğretimlerinde BSB'ye yer vermeleri için önerilerde bulunulmuştur.

Anahtar kelimeler: Bilimsel Süreç Becerileri, Fen Öğretimi, Planlanmış Davranış Teorisi, Sınıf Öğretmeni Adayları, İçerik Analizi

INTRODUCTION

Science process skills (SPS) have a central role in students' learning of science and thus development of SPS has been identified as a major goal of science education curricula worldwide (Harlen, 1999). In order for students to develop these SPS, teachers have a crucial role of creating suitable learning environments in which students have opportunity to experience SPS and encouraging their students to use these skills (Arslan & Tertemiz, 2004; Germann & Aram, 1996).

As stated by Germann and Aram (1996), teachers should give students feedback and be model for their students' use of SPS in investigations. Relating context of students' investigations with real life context contributes to students' application of SPS outside of the school, as well (Germann & Aram, 1996). However, teachers' teaching practices are influenced from their beliefs (e.g., Alhendal, Marshman, & Grootenboer, 2016). According to the theory of planned behavior (TPB; Ajzen, 2013a), beliefs regarding likely behavioral outcomes, beliefs on others' normative expectations, and beliefs related to presence of facilitating or impeding elements form individuals' behaviors. Accordingly, the purpose of the present study was to investigate salient beliefs of pre-service primary school teachers (PPSTs) in terms of addressing SPS in their future science teaching.

SPS

SPS are defined as "a set of broadly transferable abilities, appropriate to many science disciplines and reflective of the behavior of scientists" (Padilla, 1990, p. 1). Several researchers have asserted that SPS provide a foundation for science learning (e.g., Harlen, 1999; Roth & Roychoudhury, 1993; Solano-flores, 2000) and empirical research suggests that SPS are in a positive relationship with desired student outcomes such as formal thinking ability (Padilla, Okey, & Dillashaw, 1983), cognitive development, and attitude towards science (Germann, 1994). Although there are different classifications, SPS are generally divided into two groups as basic SPS and integrated SPS. As pointed out by Padilla (1990), integrated SPS are more complicated than basic SPS and basic SPS provide a basis for gaining integrated SPS. While basic SPS incorporate observing, inferring, measuring, communicating, classifying, and predicting, the integrated SPS involve controlling variables, defining operationally, formulating hypothesis, interpreting data, experimenting, and formulating models (Padilla, 1990). Basic SPS need to be optimally internalized in order to achieve higher levels of integrated SPS (Cansız, 2018).

Background

In Turkey, since 2000, science curriculum has followed constructivist approach and active role of students is brought into prominence. The latest science curriculum was revised in 2018. The new science curriculum also highlights inquiry based learning and accordingly recommends teachers to use problem based learning, project based learning, argumentation, and cooperative learning in their science teaching. It also emphasizes the importance of developing students' SPS such as observing, measuring, classifying, recording data, hypothesizing, changing and controlling variables, and doing experiment (Ministry of National Education, 2018).

Some studies conducted in Turkey investigated pre-service teachers' level of SPS and they reported that PPSTs and science teachers have moderate level of SPS (e.g., Akar, 2007; Aktaş & Ceylan, 2016). For instance, Aktaş and Ceylan (2016) examined Turkish pre-service science teachers' (n= 147) SPS. The data were collected through questionnaires and descriptive analysis results showed that pre-service teachers have moderate level of SPS. They were better on experimenting and interpreting data than they were on recognizing variables and defining operationally. In another study, Celep and Bacanak (2013) investigated teachers' perceptions of SPS and attainment of SPS by students. Participants of the study were 5 teachers attending master's degree program. The data were collected through semi-structured interviews and content analysis was conducted. Participants mentioned that SPS are beneficial for students because by using SPS, students reach scientific knowledge, develop different perspectives to solve problems, and improve self-efficacy beliefs. Furthermore, they thought that SPS contribute to students' active learning, life-long learning, and meaningful learning. Aforementioned studies examined pre-service teachers' level of SPS and teachers' perceptions of SPS. However, we have not encountered any study which investigated Turkish pre-service teachers' salient beliefs, more specifically, behavioral beliefs, normative beliefs, and control beliefs in regard to addressing SPS in science teaching.

TPB

In order to explore salient beliefs of PPSTs in regard to addressing SPS in their future science teaching, Ajzen's (1991) TPB was used as a theoretical framework. According to the TPB, as described by Ajzen (2005), *intention* to carry out (or not to carry out) a behavior is presumed to be the most significant instant determining factor of the behavior and is formed by three fundamental factors including *attitude toward the behavior*, *subjective norm,* and *perceived behavioral control*. Attitude toward the behavior is resulted from *behavioral beliefs* (i.e., beliefs pertaining to the action's outcomes) while subjective norm is produced by *normative beliefs* (i.e., beliefs concerning particular persons' or groups' approval or disapproval of carrying out the action or beliefs related to these persons' or groups' engagement or disengagement in the action). Perceived behavioral control, on the other hand, is underlain by *control beliefs* (i.e., beliefs regarding existence or nonexistence of factors to ease or hamper carrying out the action). Ajzen (2013b) highlighted the need of a pilot research to specify salient behavioral, normative, and control beliefs. In view of that, as a first step to inspect possible factors related to implementation of SPS, the present study intended to identify PPSTs' salient beliefs, more specifically behavioral beliefs, normative beliefs, and control beliefs, related to addressing SPS in their future science teaching.

METHOD

In this study, a qualitative research approach was employed to identify PPSTs' salient behavioral beliefs, normative beliefs, and control beliefs related to addressing SPS in their future science teaching. More specifically, a questionnaire comprising open-ended questions was administered to participating PPSTs, which was followed by one-to-one interviews. Responses to open-ended questions and interview transcripts were analyzed through content analysis.

Participants

The study was carried out with 12 volunteer junior PPSTs (mean age = 21.33 years, *SD* = 0.65 years) from a public university in central region of Turkey. Of these PPSTs, 4 were male and 8 were female. All of the participants had taken courses with regard to science content including General Biology, General Chemistry, and General Physics as well as courses addressing SPS including Science and Technology Laboratory Applications I – II and Science and Technology Teaching I.

Instrument

Data were gathered through a questionnaire aimed to specify participants' salient behavioral beliefs, normative beliefs, and control beliefs with respect to addressing SPS in their future science teaching. The questionnaire comprised open-ended questions (see Table 1), which were adapted from a guideline for detecting salient beliefs recommended by Fishbein and Ajzen (2010). The open-ended questions pertaining to behavioral beliefs seek for outcomes of addressing SPS in science teaching, the questions related to normative beliefs investigate normative referents that would approve or disapprove of carrying out the action or that would think participants should or should not address SPS in science teaching, and the ones concerning control beliefs search factors that would facilitate or impede participants' implementation of SPS.

Table 1. Open-ended questions for identifying salient beliefs

	Open-ended Questions
Behavioral Outcomes	What do you see as the advantages of addressing SPS in your future science teaching?
	What do you see as the disadvantages of addressing SPS in your future science teaching?
Normative Referents	Who/Which institutions would approve of addressing SPS or think you should address SPS in your future science teaching?
	Who/Which institutions would disapprove of addressing SPS or think you should not address SPS in your future science teaching?
Control Factors	Which factors or circumstances would make it easy or enable you to address SPS in your future science teaching?
	Which factors or circumstances would make it difficult or prevent you from addressing SPS in your future science teaching?

Data Collection and Analysis

Data collection was done individually by the first author of the study through administering the questionnaire to the participants, which was followed by one-to-one interviews to make the participants' responses to the questionnaire clear. All of the interviews were audio-recorded and transcribed. Content analysis was utilized to analyze data. PPSTs' responses to open ended questions and interview transcripts were analyzed independently by both researchers for outcomes of addressing SPS in science teaching, normative significant referents, and factors that may facilitate or hinder addressing SPS in science teaching. Then, findings of the analyses were compared and differences were discussed until reaching a consensus. The most frequently stated responses and responses that were evaluated to be important by the researchers were specified to describe the sample.

RESULTS

With the aim of identifying positive consequences of addressing SPS in science teaching, the participants were asked "What do you see as the advantages of addressing SPS in your future science teaching?" Consequences which were most frequently stated and which were evaluated to be important by the researchers were presented in Table 2. Accordingly, most of the participants (*n*= 9) believed that addressing SPS in science teaching allows students to learn knowledge permanently. Almost half of the participants (*n*= 5) stated that addressing SPS in science teaching enables students to use these skills in daily life and to learn by doing. One third of the participants (*n*= 4) believed that it facilitates students' learning of science content. One fourth of the participants (*n*= 3) explained that it makes knowledge more concrete for students, increases students' interest in science classes, and allows students to think. PPSTs also asserted that introducing SPS into science teaching helps students develop a positive attitude towards science (*n*= 2) and learn how scientific knowledge is constructed (*n*= 1).

Examples of the PPSTs' responses with regard to advantages of addressing SPS in science teaching were provided below.

> *"When we integrate science process skills into the lesson, knowledge can become more concrete in student's minds and [the student] learn by doing while using skills such as observation and measurement. A more permanent learning is provided [by integrating science process skills into the lesson] than only using direct instruction." (PPST 9)*

> *"I think that when science process skills are integrated, the knowledge learned [by students] will be more permanent, students' interest in the course and achievement will increase, and students will use these skills to solve their problems in daily life." (PPST 3)*

> *"The student learns to learn knowledge. The child is reaching information her/himself through observing, doing experiments, or recording the data. As s/he is active, s/he knows what to do. … I think since s/he reaches information her/himself, her/his learning gets easy." (PPST 1)*

The participants were next asked "What do you see as the disadvantages of addressing SPS in your future science teaching?" with the aim of specifying negative consequences of addressing SPS in science teaching. The most frequently cited outcome was about time limitation: One third of the PPSTs (*n*= 4) mentioned that the time left for science subjects will be short. Instances of participants' responses were given below:

> *"…if science course [is held] two-hours per week, if I do particular implementations and so forth we can experience a serious shortage of time." (PPST8)*

> *"For example, while teaching a subject faster through direct instruction, by making students active it may take time for about lesson as well as for instance if I am going to do experiment, my preliminary preparation and research on this subject may be time consuming." (PPST5)*

> *"There may be a shortage of time for the implementation of these processes in the lesson." (PPST7)*

Table 2. Outcomes of addressing SPS in science teaching

Advantages of their addressing SPS in science teaching	f
It allows students to learn knowledge permanently	9
It enables students to use these skills in daily life	5
It enables students to learn by doing	5
It facilitates students' learning of science content	4
It makes knowledge more concrete for students	3
It increases students' interest in science classes	3
It allows students to think	3
Students develop a positive attitude towards science	2
Students learn how scientific knowledge is constructed	1

Disadvantage of their addressing SPS in science teaching	
The time left for science subjects will be short.	4

In order to reveal normative referents related to addressing SPS in science teaching, PPSTs were initially asked "Who/Which institutions would approve of addressing SPS or think you should address SPS in your future science teaching?" Referents which were most frequently pointed out and evaluated to be important by the researchers were given in Table 3. Parents (*n*= 10) emerged as the most prominent agent identified by PPSTs which was followed by school administrators (*n*= 7). Rest of the responses included primary school teachers (*n*= 3), academicians (*n*= 2), students (*n*= 1), elementary science teachers (*n*= 1), and Ministry of Education (*n*= 1).

Examples of the PPSTs' responses were provided below:

> *"School manager, families, students approve [addressing SPS in science teaching]" (PPST12)*

> *"A school manager who wants students in his/her school to be successful and families of the children who want the same success may think the necessity of this." (PPST4)*

> *"Parents of students can enjoy the integration of science process skills into the science course and approve [addressing SPS in science teaching] since it provides their children with more permanent learning." (PPST9)*

Next, PPSTs were asked "Who/Which institutions would disapprove of addressing SPS or think you should not address SPS in your future science teaching?" (See Table 3). Most of the participants (*n*= 9) believed that school administrators and more than half of the participants (*n*= 7) stated that parents would disapprove of their addressing SPS in science teaching or think they should not address SPS in science teaching. Primary school teachers (*n*= 3) and students (*n*= 1) were other responses given by PPSTs.

Instances of the PPSTs' responses were provided below:

> *"The administration may not approve because they can think [it is] unnecessary, waste of time and material." (PPST9)*

> *"Teachers who think that these skills do not benefit students and school administrators who think that these skills are absurd, parents who do not know the basics of these stages [would disapprove addressing SPS or think I should not address SPS in science teaching]" (PPST11)*

Table 3. Normative referents related to addressing SPS in science teaching

Persons/institutions that would approve of participants' addressing SPS in science teaching or think they should address SPS in science teaching	f
Parents	10
School administrators	7
Primary school teachers	3
Academicians	2
Students	1
Elementary science teachers	1
Ministry of Education	1
Persons who would disapprove of participants' addressing SPS in science teaching or think they should not address SPS in science teaching	
School administrators	9
Parents	7
Primary school teachers	3
Students	1

In order to reveal control factors in regard to addressing SPS in science teaching, the participants were firstly asked "Which factors or circumstances would make it easy or enable you to address SPS in your future science teaching?" PPSTs' most frequently mentioned responses to this question were given in Table 4. Half of the participants (*n*= 6) mentioned that availability of laboratory equipment and materials at school would ease their implementation of SPS. One third of the participants (*n*= 4) stated that presence of a laboratory at school, small class size, availability of technological devices *(smart board, projector, etc.)* at school, support from school administrators, and presence of natural diversity in the school environment would help their SPS instruction. One fourth of the participants (*n*= 3) identified that students' willingness to learn, easy access to the materials in the school environment, and support from parents would facilitate their implementation of SPS in science teaching. Instances of the responses given by the participants were given below.

> *"... if there is an equipped-laboratory, it is easier for me. That is to say, I can find material for every student… For example, there can be a projector in a classroom or size of the classroom, physical properties of the classroom can affect me. ... if table and desks are appropriate, I can form groups, [they] can make observation in groups. These make my work easier. .... If the students are eager, they listen to me better, but if they are not reluctant, whatever I do is not useful for students." (PPST4)*

> *"Attitudes of students in classroom toward science…If [students'] attitude is positive, [it] facilitates, if [students'] attitude is negative, it makes [implementation of SPS] difficult. …The environment and structure of my classroom and school: For example, if I am in a village school, the facilities are limited. I mean things I can do is limited. Or, if I am in a center [school located in the center], this time having permission from families, having permission from school administration, this way of difficulty and there are also good sides; the environment the school is located and the school's structure is important for this. First of*

all, school administration must give approval to what the teacher wants to do. If they find it appropriate, they need to help in this way. If a tool is missing, for example, they can provide them. With family, in the form of cooperation with family, they can provide tools. In this way they can help the teacher. If they don't, they make the teacher's job harder." (PPST8)

"The school should be an equipped, big school; but if class size is small, [it] eases. For me, an equipped school is a school where there are laboratory facilities, technological; where computers, smart boards exist, and locating where we can easily get the material we want." (PPST5)

Then, PPSTs were asked "Which factors or circumstances would make it difficult or prevent you from addressing SPS in your future science teaching?" Most frequent responses given by the PPSTs were provided in Table 4. Crowded classroom (*n*= 7) and inadequate laboratory equipment and materials at school (*n*= 7) emerged as the most frequently stated impeding factors for their implementation of SPS in science teaching. Limited natural diversity in the school environment (*n*= 4) and students' unwillingness to learn (*n*= 3) were other hindering factors identified by the participants.

Examples of the responses given by the participants were provided below:

"Lacking of laboratory equipment at school, lacking of a laboratory, crowded classroom [make addressing SPS in science teaching difficult]" (PPST2)

"Physical conditions, that is, if the class is small or in a village school it may be difficult to do experiments. That is, if the tool, equipment are missing, then of course it can be a bit difficult. Experiment materials, such as beaker, ... if they are hard to supply, maybe it can be difficult for science course. If the class is crowded, if students do not come to school in the villages, we do not implement SPS... If the school garden is not suitable, [we may not be able to do] activities in the garden..." (PPST11)

Table 4. Control factors related to addressing SPS in science teaching

Factors or circumstances that would make it easy or enable participants to address SPS in science teaching	f
Availability of laboratory equipment and materials at school	6
Presence of a laboratory at school	4
Small class size	4
Availability of technological devices *(smart board, projector, etc.)* at school	4
Support from school administrators	4
Presence of natural diversity in the school environment	4
Students' willingness to learn	3
Easy access to materials in the school environment	3
Support from parents	3
Factors or circumstances that would make it difficult or prevent participants from addressing SPS in science teaching	
Crowded classroom	7
Inadequate laboratory equipment and materials at school	7

Limited natural diversity in the school environment	4
Students' unwillingness to learn	3

DISCUSSION

As students ask questions, make predictions, design investigations, collect and interpret evidence, and communicate results, which is they use SPS, students make sense of their experiences, develop their ideas, and thus learn science concepts meaningfully (Harlen, 1999). Therefore, several researchers have emphasized importance of including SPS in science instruction (e.g., Germann & Aram, 1996; Solano-flores, 2000). Teachers' incorporation of SPS into science teaching is also encouraged by Ministry of National Education in Turkey (Ministry of National Education, 2018). The present study attempted to specify PPSTs' salient beliefs including behavioral beliefs, normative beliefs, and control beliefs about addressing SPS in science teaching. More specifically, behavioral outcomes, normative referents, and control factors for PPSTs' introducing SPS into science instructions were examined.

As far as behavioral outcomes are considered, PPSTs appeared to believe that addressing SPS in science teaching results in largely positive consequences. Some consequences are associated with students' learning. Specifically, incorporation of SPS into science teaching allows students to learn knowledge permanently, enables students to learn by doing, facilitates students' learning of science content, makes knowledge more concrete for students, allows students to think, and allows students to learn how scientific knowledge is constructed. Besides students' learning, PPSTs believed that implementation of SPS in science teaching has positive consequences in terms of students' motivation in and attitudes towards science. PPSTs explained that it increases students' interest in science classes and allows students to develop a positive attitude towards science. Furthermore, PPSTs mentioned that addressing SPS in science teaching enables students to use these skills in daily life. These findings are not surprising since activities, in which students observe, infer, measure, communicate, classify, predict, and conduct experiments, provide them with opportunities to learn science through active participation, to experience skills and processes related to construction of scientific knowledge, to think in a critical manner, and to make abstract scientific concepts more concrete for them. These, in turn, are likely to result in meaningful and permanent learning. Moreover, if students are active in learning process and their learning is meaningful and permanent, they may develop a positive attitude towards science. Furthermore, students with adequate understanding and practices of SPS are likely to apply their understanding and practices into their daily lives. Previous research findings also suggest that SPS are positively related to students' formal thinking ability (Padilla et al., 1983), cognitive development, and attitude towards science (Germann, 1994). Thus, PPSTs' beliefs about positive consequences of addressing SPS seem to be quite reasonable.

On the other hand, in regard to unfavorable consequence of addressing SPS in science teaching, PPSTs felt that the time left for science subjects would be short. PPSTs' mentioned concern may be due to their perceptions about significance of science subjects comparing to SPS. More specifically, they may think that teaching science subjects is more important than teaching SPS. However, as mentioned beforehand, SPS provide a foundation for science learning (Roth & Roychoudhury, 1993; Solano-flores, 2000) and by using SPS, students learn science concepts meaningfully (Harlen, 1999).

With respect to addressing SPS in science teaching, PPSTs specified approving or expecting agents as parents, school administrators, primary school teachers, academicians, students, elementary science teachers, and Ministry of Education whereas agents that are not approving or expecting as school administrators, parents, primary school teachers, and students. These findings are interesting that referents including school administrators, parents, primary school teachers, and students were perceived both to approve/expect and to disapprove/not to expect participants' addressing SPS in science teaching. It seems that some participants are not sure about important referents' opinions with respect to implementation of SPS. According to PSSTs, for instance, parents who value SPS may approve their implementation of SPS whereas parents who do not give importance to SPS may perceive its implementation as a waste of time. Hence, based on the PPSTs' perceptions, the importance of SPS for effective science instruction seem not to be well comprehended by significant normative referents.

In regard to control factors, PPSTs generally identified that school-related factors would facilitate their introduction of SPS into science teaching. Namely, presence of a laboratory, availability of laboratory equipment and materials, availability of technological devices *(smart board, projector, etc.)* at school would help their addressing SPS. Inadequate laboratory equipment and materials at school was also mentioned by PPSTs as an impeding factor for their implementation of SPS. Easy access to the materials in the school environment is another facilitating factor specified by the PPSTs. In Turkey, when they are appointed to primary school teachers, they generally began to work in schools located in rural areas and villages where there may be deficiency of laboratory equipment and technological devices or it may be difficult to access materials. Their responses point out the PPSTs' concerns about these issues and according to them well-equipped schools would ease their incorporation of SPS into science teaching. Although some of the SPS do not require material support, such as hypothesizing, in order to utilize some of the SPS, like experimenting, particular type of materials may be needed. Furthermore, small class size was identified as a facilitating factor while crowded classroom was specified as an impeding factor by PPSTs because in crowded classrooms it may be difficult for them to guide every students' use of SPS. Moreover, PPSTs expect that if school administrators and parents value SPS and support implementation of SPS in science lessons, they may supply materials needed and give necessary permissions. For instance, in order to bring students to a place where they can make observations and collect data, primary school teachers need to get permission from both school administrators and parents. Thus, support from these parties may help addressing SPS in science teaching. According to PPSTs, natural diversity in the school environment would facilitate their implementation of SPS in science teaching whereas limited natural diversity in the school environment would make it difficult. When teaching some of the science topics, natural diversity in the school environment might be useful, such as classifying things around as living and non-living. Lastly, PPSTs mentioned students' willingness as a facilitating factor for addressing SPS in science teaching while students' unwillingness to learn as an impeding factor. If students' willingness is high, they may participate in science activities and use SPS more efficiently and if their willingness is low they may be reluctant to implement SPS. Therefore, a number of control factors that would facilitate or impede PPSTs' using of SPS during science teaching have been identified.

Considering the significance of beliefs about a behavior to its performance (see Ajzen, 2013a), it seems sound to infer that in order for PPSTs to address SPS in their future science teaching, they should believe that implementing SPS when teaching science brings about affirmative outcomes, should feel that referents important to teaching would approve of their teaching of SPS or think they should teach SPS, and should not perceive that there are many factors as impediments to including SPS in science teaching. The current research revealed that PPSTs appeared to believe that addressing SPS in science teaching results in mainly positive consequences; however, they had concern about the time left for science subjects. We attributed this concern to PPSTs' perceptions about the importance of science subjects comparing to SPS. We recommend that the significance of SPS to teaching of science as well as students' learning of science should be stressed in teacher education programs. PPSTs, for instance, can be given opportunity to experience SPS during their teacher education programs and especially courses of Science Laboratory Applications and Science Teaching are convenient for this purpose. As well, PPSTs can be encouraged to implement SPS during Science Teaching Methods and Teaching Practice Courses. As PPSTs grasp importance of SPS and practice incorporating SPS into their teaching, their concern about the time may reduce.

In addition, this study resulted in normative referents with respect to addressing SPS. Some participants did not appear to be certain about expectations of significant referents involving school administrators, primary school teachers, parents, and students. We suggest that importance of SPS for science education should be conveyed to school administrators, primary school teachers, parents, and students. Furthermore, the present study resulted in factors that would facilitate and obstruct PPSTs' addressing SPS in science teaching. Considering the identified factors, educational settings can be designed to promote implementing SPS when teaching science. Accordingly, presence of a laboratory, laboratory equipment and materials, and technological devices at school may be useful. Schools which do not have these facilities should be equipped. Natural diversity and easy access to materials in the school environment may ease their addressing SPS in science teaching. Small class size seems to facilitate their implementation of SPS while crowded classroom prevents them from addressing SPS. Thus, reducing number of students in the classes may be useful. Support from school administrators and parents also facilitate their implementation of SPS. Seminars may be given to these parties in which importance of SPS is explained and how they can support addressing SPS in science classes. Lastly, students' unwillingness to learn seems to be an impeding factor for PPSTs' teaching of SPS. Indeed, if students are provided with science activities in which they have opportunity to use SPS, students' engagement may increase. Again, importance of addressing SPS in science teaching can be emphasized in the aforementioned courses in teacher education programs.

Even though the present study findings contribute to our understanding of PPSTs' beliefs related to addressing SPS in science teaching, this study was limited to 12 junior PPSTs from a public university located in central region of Turkey. Since participants were from the same grade level and the same university, it seems likely that participating PPSTs held similar beliefs. Hence, further studies can be conducted with more participants from diverse grade levels and diverse universities. In addition, future research can investigate PPSTs' beliefs about teaching SPS with respect to grade level and universities.

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