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What do Science Teachers Expect from a Technology-Based Professional Development Program?: Reflections from a Pilot Study

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This study aimed to reveal science teachers' expectations from a technology-based professional development program and designate the said program accordingly. The case study was carried out with 12 science teachers of gifted students. In order to identify the needs of the teachers for effective technology integration in the classes, interviews were conducted. The interviews unearthed that the use of technology in classes was mainly at a basic level, and resorted to with a view to providing visualization, make presentations, or web-search. The teachers declared that they would like to attend technology-based training programs to improve their technology competencies. After determing the teachers' needs, the researchers developed a technology-based professional development program based on the ASSURE model and implemented the pilot study. After the pilot study, the participants put forth that the program was beneficial for enriching classes with technology in various ways. It is thought that the dissemination of this training by making extensive applications to teachers in different fields will contribute to the development of their technological competencies and help overcome the difficulties in the use of technology. In order to enhance the technological competence of teachers, technology-based trainings need to be designed and thereupon overcoming the barriers to technology usage can be made possible. It is recommended to carry out studies to evaluate teachers' technological abilities and efficiencies in other ways and pursue them according to their developmental characteristics.

Introduction

With 21st-century skills, teachers should be competent in using appropriate technologies and designing lessons to create a new learning culture (Chai et al., 2017). To this end, many applications and tools are used in the technology-supported programs; the main ones are Web 2.0 applications, mobile applications, and social media (Pan & Franklin, 2011; Rosenberg et

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al., 2017). Such tools have generally been used in recent years and have become widespread in education, but more research is needed on-the effective use of teacher competencies (Ajjan & Hartshorne, 2008; Martin et al., 2011; Shahid et al., 2019). Besides, some research findings revealed deficiencies in meeting the technology needs of teachers and in their use (Besnoy, 2007; Chen et al., 2013; Periathiruvadi & Rinn, 2012; Shaunessy, 2004).

Although teacher training is a limited study area, some scholars contribute to its improvement via professional development (PD) programs (Chikasanda et al., 2013; Zhang et al., 2015). Designing a PD environment is crucial for teachers to gain new experiences (Putnam & Borko, 2000; Lindvall et al., 2018). One of the groups that should be organized more PD programs is science teachers in actual practice, as the subjects include practical application content (Shaharabani & Tal, 2017). Science teachers' PD programs are encouraged to be based on a constructivist approach to experience innovative science activities selected from various strategies for high-quality science teaching (Posnanski, 2002).

Studies on technology-based activities for science teachers had positive outcomes. For instance, Cetin (2016) developed a PD program for science teachers that utilized an inquiry-based model with interactive computer simulations and revealed that most participants initially lacked the necessary skills and knowledge for teaching. Still, the program gave them positive opinions on using computers and provided ways to integrate Information and Communication Technologies (ICT) successfully. Another PD program for science teachers project conducted by Lavonen et al. (2006) showed that the participants used ICT extensively and integrated it into their science education programs. Similarly, Klieger et al. (2010) developed a PD program and revealed that the introduction of laptops to the teachers and students and the support and training system positively affected science teachers' PD. Also, the program contributed significantly to teachers' professional and personal development and shifted the focus from teacher-centered to student-centered science teaching.

The content in science lessons is crucial for all students, but it becomes critical for teachers of gifted students (Benny & Blonder, 2016). However, the number and continuity of studies performed with teachers of gifted students are limited (Reid & Horváthová, 2016). PD programs for teachers working with gifted students have proven effective in their classes (Benny & Blonder, 2016; Matthews & Foster, 2005). One way to develop an effective PD program could be to question the use of technology for the teaching activities to improve the students' abilities, creativity, and productivity. Innovative implementations and practices play an essential role in science teachers' PD (Shaharabani & Tal, 2017).

However, some challenges for teachers might occur when integrating technology into learning environments to enrich or differentiate their lessons. Teachers sometimes have difficulties changing their styles and using different techniques, so sustainable PD programs should be applied to improve their knowledge and provide the help they need (Benny & Blonder, 2016; Loucks - Horsley & Matsumoto, 1999; Mohammadi & Moradi, 2017). Besides, it is not only necessary to provide training to teachers of gifted students and contribute to their teaching competencies but also essential to reveal their expectations from a PD program. Thus, it is determined to develop a technology-based program for teachers according to their opinions and based on their needs. It was thought essential to carry out enrichment practices for science teachers working on joint projects with an interdisciplinary approach. The current study aimed to reveal the expectations of teachers from a PD program and prepare a technology-based PD program for science teachers (physics, chemistry, biology, and science) of gifted students.

Literature Review

One of the main topics that make up 21st-century learner skills is "digital literacy skills." Trilling and Fadel (2009) defined digital literacy skills as information curiosity, fluency in media use, and learning skills built with technology. In addition, it is stated that the skills of 21st-century learners to use 21st-century media and communication tools such as videos, podcasts, web pages, and web 2.0 tools effectively and efficiently in their learning processes are essential (Göksün & Kurt, 2017). Thus, teachers' pedagogical content knowledge about information technologies is vital for developing students' 21st-century skills, and they should benefit from these technologies (Voogt et al., 2013).

Thurm & Barzel (2020) found that in the technology-supported professional development program for mathematics teachers' frequency of technology use increased during the PD program. Koh et al. (2017) determined that the PD program positively affected teachers' confidence in Technological Pedagogical Content Knowledge (TPACK) knowledge. Guzey and Roehrig (2009), on the other hand, designed a technology-assisted development program for science teachers to support the development of research and inquiry skills. They observed that the organized program contributed to the development of teachers' TPACK skills and integrated technology into their lessons. In addition to these findings, there is also some research that the use of technology is beneficial in many ways in gifted education. Some studies are addressing that ICT tools support the education of gifted students. For instance, Martin et al. (2011) asserted that technology in gifted education is essential and should be used. Siegle (2019) stated that the role of technology in education, especially in the education of gifted students, is constantly growing. The pedagogical programming and learning environment used by Shin et al (2013), revealed that it was beneficial for gifted students to improve their 21st century skills such as creativity, problem-solving abilities and collaborative learning. However, teachers' technological competencies are not at the required level and display deficiencies (Besnoy et al., 2012; Buckenmeyer, 2010). Therefore, the education of teachers of the gifted should be given importance and practical training and studies should be performed to support their PD. Teacher training studies on the education of gifted are needed, as there are few existing studies in this area (Reid & Horváthová, 2016). It is emphasized that teacher education should be conducted in line with the requirements of 21st-century skills in studies related to the PD of teachers, and more studies should be conducted for the development for teachers of gifted students (Brigandi et al.,2019; Lee & Jin, 2015; Sheffield, 2007).

Integrating science lessons with technology is important for conducting an effective learning process and there is limited research on how to support teachers for integrating technology effectively into lessons (Hutchison &Woodward, 2018). More empirical research should be conducted on newly emerging Web 2.0 technologies and their effectiveness regarding gifted students (Periathiruvadi & Rinn, 2012). According to Besnoy et al. (2012), instructional technologies in the classroom could attract students and provide enrichment experiences by encouraging further learning. It is necessary to detemine the needs of teachers of gifted students' PD. For this reason, it is suggested to conduct both training and PD support for teachers of gifted students (Kontaş & Yağcı, 2016; Satmaz & Evin-Gencel, 2016).

The ASSURE model

The ASSURE model is one of the appropriate instructional designs to be implemented in technology-based professional development programs. It is among the prominent advantages of the model that it can be used for each student, both classroom-oriented and individually, and that a few hours of instruction can be applied (Baran, 2010). The ASSURE model is a popular education model that teachers can use to plan technology integration into the teaching lesson (Shelly et al., 2012). It consists of the initials of the stages that make up the model. The ASSURE model is expressed as a practical and easy-to-apply design model used to integrate technology into the classroom (Kim & Downey, 2016). The components of the ASSURE model is explained in detail below.

- Analyze learners
- State standards and objectives
- Select strategies, technology, media and materials
- Utilize technology, media and materials
- Require learner participation
- Evaluate and revise

(Kim & Downey, 2016; Smaldino et al.,2005; Smaldino et al., 2008).

The “analyze learners” stage comprehends determining learners’ entry features, general characteristics, specific competencies, and learning styles. At the “State objectives” stage, it is expected from the learners, that the goals to be achieved and the gains that the learners should acquire should be expressed.

The “Select strategies, technology, media, and materials” stage refers to selecting appropriate media, technology, or materials for designing classes for learners. The “utilize technology, media, and materials” step is planning effectively for the course by choosing appropriate materials to be used by the learners. At the “require learner participation” stage, the learners must be actively involved in the classes. Lastly, the “evaluate and revise” step is determining the impact of the classes and the process entirely and making appropriate revisions and corrections if necessary (Baran, 2010; Gustafson & Branch,2002; Heinich et al., 1999). Based on a process-oriented model, the ASSURE model uses a standardized inquiry-based approach to lesson planning that can be used school or district-wide (Smaldino et al., 2015). Furthermore, Gustafson & Branch (2002) emphasized that the model has much to offer classroom teachers because of its steps and an authentic environment. They stated that the models' practical guidance and structure make it easy to apply in classes.

Method

This research is a qualitative study and designed as a case study. It is classified with an instrumental case study pattern and recognizing the details and complexity of a situation provides an understanding of the subject (Stake, 1995). The case in this study was the status and expectations of teachers of the gifted in need of a technology-based PD program and develop it within this regard. In addition, a pilot study was conducted for the developed program along with the examination of teachers' views.

Context of the study

Since the research aimed to reveal teachers of gifted students' expectations from a technology-based PD program and see their opinions, it was conducted at SACs.

Science and Arts Centers

Science and Arts Centers (SACs) are institutions established to assist gifted students in receiving training, mostly based on hands-on activities and practical exercises that support their potential. Project-based and interdisciplinary activities are organized for the enrichment and differentiated educational programs are conducted according to students' abilities at SACs. The work of at SACs based on creation of authentic work, original products, projects, after the formal education lesson hours or on weekends. The work that conducted at SACs are based on creation of authentic studies, original products, projects which held after the formal education lesson hours or on weekends (MoNE, 2016). Students handle elementary science, physics, chemistry, and biology lessons with an interdisciplinary approach based on their level. They focus on these fields according to their interests and then participate in original projects at the SACs. Fields of elementary science, physics, chemistry, and biology teachers collaborate simultaneously during the project process. The curriculum implemented at SACs is structured to include a framework and it allows the content to be determined by the teachers working there; hence, flexibility is possible (Altun & Vural, 2012).

Participants

The maximum diversity sampling method of purposeful sampling was selected. Thus, when describing the needs of teachers of the gifted, the opinions from science teachers were gathered working at the SAC who provided supportive after-school education to gifted students. They work in different cities and voluntarily took part. Face-to-face interviews were conducted with 12 teachers working at SACs in various provinces during the analysis of the need procedure for the PD program. The pilot study participants consisted of four participants who were two females and two males working at SACs of science fields, apart from the group who took part in the analysis of needs procedure. Volunteer participants were regarded in the pilot study, to assess the suitability of the data-collection tool. Participants at this part of the study were coded as T1, T2, T3, and T4 (starting with the letter "T" and continuing with a number). By contrast, participants in the pilot study were coded as P1, P2, P3, and P4 (starting with the letter "P" and continuing with a number). The characteristics of participants within analysis of needs procedure is given in Table 1 below.

Table 1. Characteristics of participants within analysis of needs procedure

Participants	Gender	Field	Average teaching exprience(in years)	Average working experience at SAC(in years)	Educational status
T1	Female	Chemistry	22	1	Masters
T2	Female	Biology	8	2	Bachelor
T3	Male	Elementary science	15	5	Bachelor
T4	Female	Elementary science	10	2	Bachelor
T5	Female	Chemistry	19	4	Bachelor
T6	Male	Elementary science	20	4	Bachelor
T7	Female	Chemistry	18	3	Bachelor
T8	Male	Elementary science	12	3	Bachelor
T9	Female	Elementary science	6	1	Masters
T10	Male	Elementary science	22	12	Bachelor
T11	Female	Elementary science	19	3	Bachelor
T12	Female	Elementary science	13	1	Ph.D.

As shown in Table 1, some teachers working at SACs had either completed a postgraduate education or were pursuing this. The experience of the teachers in this group differed. However, it is understood that they are close to each other during work periods at SAC. The participants in the pilot study included four science teachers (two female and two male) working at SACs. They had at least four years of experience, and their overall experience was more than 15 years.

Data Collection Tool

The data collection process started with situation analysis and the analysis of needs. After the literature review, information about the current situation was obtained and identified the insufficiencies. It was necessary to interview teachers working at SACs. The interviews were conducted within a project conducted by other researchers, excluding current researchers. We contacted the head of the project and after gaining permission and approval and participated as observers in the project. During this period, the interviews were conducted with 12 participants of the project when they were available (in their free time). The semi-structured interview questions for participants were prepared in the context of the research and they were updated after gaining the opinions of the two science education experts. Interviews were conducted individually with the participants for situation analysis and the analysis of needs. They were also questioned about technology and its use in lessons, technology in the education of the gifted, and their expectations for a technology- based PD program during the interviews. Moreover, after the pilot study, interviews were conducted to evaluate the program with the pilot study's participants individually. All of the interviews were audio-recorded.

Development of a technology- based PD program

While developing the program, it was initially investigated teacher competencies in science education and teaching PD programs. The literature on the education of gifted individuals and the education of their teachers was examined. Besides we took opinions from experts from various fields. The fields of the experts whose opinions are sought for the PD program are science education, computer and instructional technology education, program development, and gifted education departments. The necessary corrections were made through their suggestions and improvements to the draft program in line with the expert opinions about the appropriateness of the gains, expressions, and technologies used. After that, permissions were obtained for implementation for the study group to carry out the pilot study.

The study group with whom the implementation would be performed was science teachers, who actively conducted many interdisciplinary studies with students at SAC. The development of the PD process is indicated in Figure 1.

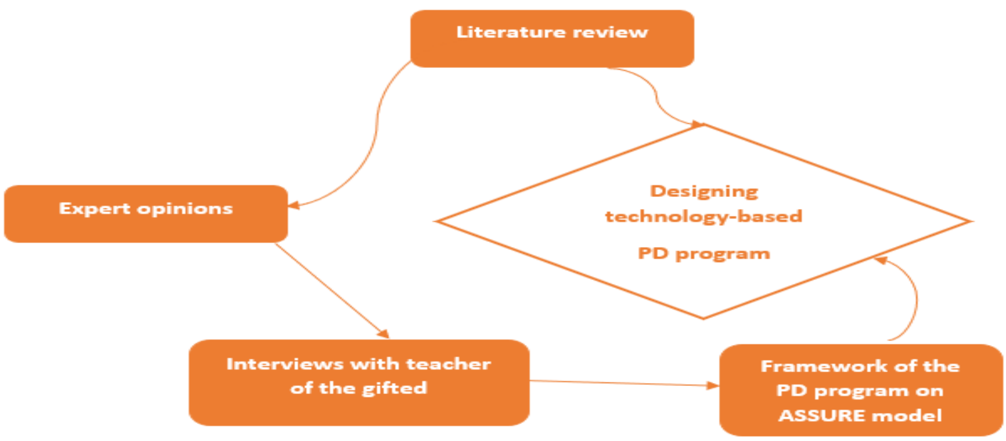

Figure 1. Development of a technology- based PD program process

As shown in Figure 1, development of the technology- based PD program process consisted of literature review, expert opinions, and interviews with teachers. The information was gathered on the teachers' use of innovative technologies, problems in technology use within the lessons and practices they held with the gifted through interviews. Technology integration-oriented questions were posed about what extent they felt competent in this field and their needs. The opinions of the teachers about the importance of technology in the education of the gifted and about the limitations and sustainability of PD programs for teachers were also gathered. The teachers' opinions regarding the importance of technology and the limitations and sustainability of PD programs for teachers were gathered in gifted education. It was thought that there was a need for a PD program for teachers of gifted students including technology use according to the literature review, experts' opinions, and interviews with teachers. According to the opinions of experts and literature and it was decided to base the framework for the program with technology on the ASSURE instructional design model. The ASSURE model is a popular education model that teachers can use to plan technology integration into the lessons (Shelly et al., 2012). It was decided to implement the technology-based program, which will be carried out according to the ASSURE model, with socio-scientific issues (SSI) via Web 2.0 tools. SSI is a subject area that deals with current problems in daily life and allows for arguments about them. The content in SSI was planned according to the stages of the ASSURE model in the implementation to be carried out with Web 2.0 tools in the technology-based professional development program. The SSI content of the implementation were assigned as follows: genetically modified organisms, the use of nuclear energy and power plants, climate change, environmental pollution, electromagnetic pollution and mobile phone use, endangered creatures, and antibiotic use. These topics enable the development of creativity, critical thinking, and persuasive skills in the education of the gifted (Lemons, 2011). In this process, the Web 2.0 tools used in the implementation were as follows: concept mapping tool, word cloud tool, visual board application, cartoon designing application, puzzle application, animation and video preparation tool, content sharing platform, and QR code applications. Research on the ASSURE model and SSI was constructed and the draft program was implemented in eight sessions. While developing the draft program, inquiry, discussion, and questioning techniques were used. The SSI subject contents were implemented according to the steps of the ASSURE model by using Web 2.0 tools.

The planning process of the pilot study

The schedule was created by determining the appropriate days and hours for implementation with participants before starting to pilot study. First, a two-hour meeting was conducted about the purpose, content, and material information of the study. The applications to be implemented within the scope of SSI were explained. Since the participants would carry out technology-based implementations within the scope of SSI, their knowledge level on this subject was examined. It was learned that they had lectures on this subject and took part in some projects before. We then assessed the appropriateness of implementing the program in terms of duration and resources before the pilot study with teachers. Then, a pre-pilot application was carried out to understand how long it would take to implement with teachers and what the necessary conditions should be in terms of implementation. The pre-pilot study was completed and recorded with three senior prospective science teachers with an audio recorder. Accordingly, the implementation was performed over eight sessions, and the process was recorded with an audio recorder. Semi-structured interviews were conducted again at the end of the process. For the implementation, a document file containing information and materials for each activity related to SSI-related topics was shared via e-mail so that teachers could use it as a resource. Considering the steps of the ASSURE model, discussions and question-answer techniques were conducted. It was aimed to clarify prior information on the subject and correct any information deficiencies. The implementation procedure of SSI subjects in the PD program based on the ASSURE model stages is described below.

- At the analysis of learners' stage: Firstly, a document file containing information and materials for each activity related to SSI-related topics was shared via e-mail. Participants were provided time to examine the resources. Information was given about the Web 2.0 tool's features, and examples were demonstrated. Questions were asked about the chosen SSI topic to examine the participants' knowledge level of current scientific developments. They were asked to make their arguments and share their views on an example SSI case situation by using the tool.
- At the stating standards and objectives stage: The goals to be achieved and the expected gains regarding the implementation were clearly stated. Expectations for the design to be created were clearly explained, and necessary information was provided. In choosing the method, environment, and materials, technology-enriched science teaching, discussion, and question-and-answer methods were used. Also, samples of newspapers, statistical information, various visuals, web sites were presented as methods and media. The participants used the Web 2.0 tools to make a design to express their opinions on the related SSI topic.
- At the stage of selecting the media and materials: It was taken into account the initial level determined during the analysis of learners and chosen the most appropriate media to appropriate design for the related SSI topic and decided on equipment and tools.
- At the stage of utilize technology, media and materials: The learning environment was optimized before implementation. The necessary elements were checked, including visual materials, samples of newspapers, case studies and statistical information, sample files, and other relevant online resources.
- At the stage of requiring learner participation, the prior knowledge about SSI and the opinions of the study group were assessed, and enough time was given for them to reflect their views by creating a design. The designs were shared on the platform built over the Web 2.0 application used to share opinions regarding these ideas. The application's features, the development of the web environment, and the details of the interface's presentation were introduced through the application. Guidance was provided to enrich the design by using content features to be added visually or through sound, color, or a video.
- At the evaluation and revision stage: It was considered necessary that the concepts of SSI addressed in the evaluation process be used correctly and that their designs should be related to the objectives. The participants were expected to share the designs they had prepared on the Web 2.0 tool (Edmodo) platform. They were included in an interactive process and viewed each other's work in terms of multiplicity, diversity, and integration of the steps taken in practice. They had discussions about each other's opinions while making their designs.

Pilot Study

A two-hour meeting was held with the participants in the pilot study. Pilot studies provide an opportunity to focus on situations that might be experienced in the main research in qualitative research and the researcher's thoughts and comments about the process (Yin, 2009). The participants were informed about the content, duration, tools and materials to be used in the implementation. The pilot study's timing program was organized per the participants' course hours that ensured voluntary participation and continuity in the practices. The implementations were held inside a science laboratory and the classroom at SAC, where the participants had personal computers and internet connections. Web 2.0 tools were used to create content and make designs to express the opinions of the related SSI topic within the pilot study of the PD program. Four participants took part in the pilot study. Data obtained via interviews were analyzed. According to the findings, it was determined that participants evaluated that the process was efficient and instructive, and they had improved their knowledge and awareness of many applications. It was also defined that participants stated that gifted students were eager regarding technology, but the teachers sometimes did not cater to them. The challenges experienced in the pilot study were related to the timing procedure.

Data Analysis

While coding the data, an open coding technique was used, and content analysis was used to analyze the data. The audio recordings obtained from interviews in the pilot study were transcribed and transferred to NVivo 12 software for analysis. After the relevant codes and theme creation processes were completed, the results were interpreted. The data from the interviews were coded separately by the researchers of this study to provide triangulation for the analysts. After we had completed the coding process separately, the coding was compared. We achieved 85% similarity, calculated by Cohen's kappa value. After this process, the codes were finalized and arranged under themes.

The Role of the Researcher

One of the researchers frequently communicated with the participants by phone after the planning process. Preliminary informational meetings were held to establish face-to-face communication regarding the practices to be accomplished. The participants were informed that they could communicate if they wondered about or needed information anytime during the implementation. To ensure the efficiency of the program prepared, participants created their products actively and individually. The participants were supported, with explanations and directions regarding the applications and contextual situations. One of the researchers was the practitioner and, conducted semi-structured interviews with the participants and was fully involved in the research process.

Findings

Findings are presented in three headings, situation analysis, analysis of the needs procedure, and pilot study results sections.

Findings of the situation analysis

The themes and sub-themes that emerged in the interviews for situation analysis were as showed at Figure 2.

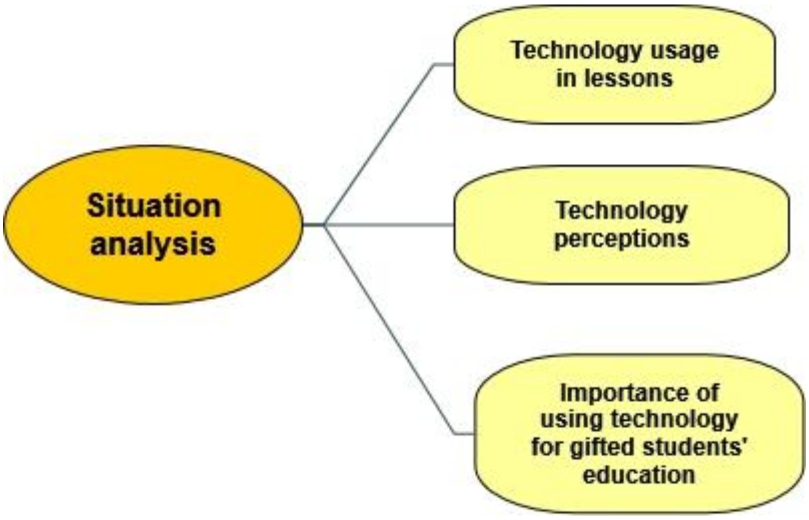

Figure 2. Sub-themes gathered at the situation analysis theme

As shown in Figure 2, it was determined that the participants mentioned using technology in lessons. They also commented on their perceptions about the technology concept and emphasized the importance of technology for gifted education during the status analysis. The participants stated that using technology in their lessons mostly for communicating and preferred to use mobile applications to support their lecturing when they could not do experiments. They also associated the technology concept with the tools used in lessons generally. Besides, the participants made various explanations about the importance of using technology in the education of the gifted and emphasized the eagerness of students to use technology. They thought it would attract students' attention, help the development of high-level skills, and save time through acceleration. Moreover, they stated it would be suitable for the project process. The sub-themes are explained respectively in detail below.

Technology usage in lessons

Regarding the use of technology in their lessons, the participants stated they used technology for supporting the experiments, lecturing, and repeating the lessons. They also added that they could use for students to attract attention to the class or enrich. Consequently, the participants frequently made explanations of the advantages of the video application tools on the smartboard to gain information about experiments or teach a subject or concept. Codes related to the theme of technology use in the course are given in Table 2 and described below.

Table 2. Technology usage in lessons sub-theme and codes

Sub-theme	Codes
Technology usage in lessons	Supporting for experiments
	Lecturing and repeating lessons
	Web-search
	Attracting attention to the lesson
	Enriching teaching

As shown in Table 2, participants mentioned using technology at lessons. They indicated that the activities they often performed in classes were based on experimenting and that they used technology at various stages of the experimental process. Some participants stated that animations or simulations were useful where the experiment could not be performed due to lack of material or problems caused by the environment. Direct quotations of participants are as follows:

"When our material are not enough, I use them to embody this in children somehow." (T3).

"Of course, if something is missing, the experiment material, for example, we can watch the videos of that experiment on Youtube." (T8).

In addition, it was stated that some programs were used in conducting the experiment. The participants explained that mobile applications were frequently used at this stage. For example, T5 said,

"But normally the child just tries to see this with the eyes, we know there are certain salts, you only see orange, for example. So you can't see the color of that salt, but when you hold onto the spectrum, you can see the color of salt, for example."

T5 added that the mobile application was used to reinforce the experiment. Hence, according to the participants, technology was used when lecturing and repeating the subject. They also emphasized the use of technology to concretize concepts and to summarize and repeat ideas.

"So we use it as a short video as an introduction at the beginning of the unit. Well, sometimes we use it for summarizing after the unit is finished, according to the duration. They have exercises, whenever they want, or they can do it online at home." (T12).

Another purpose of using technology in lessons was to search for resources to enable students to research a topic or to find documents related to homework. This expression was mentioned as *"... Let's turn on that computer, do this research"* was used by T1. It emerged that one purpose of the use of technological tools by the participants was to enrich, with visuals, the subjects in their lessons. They preferred to use the contents with template samples at the beginning of the lesson to attract students. T8 explained the matter this way:

"At the beginning of the event, if I don't have materials that will attract their attention, I can instantly open the smart board and show diagrams, photos, even many applications related to the subject at the end of the event." (T8).

The participants thought that technology should enrich their teaching. They presented their views for accelerating the process when necessary or differentiating it according to the content or to the individual characteristics of students. Furthermore, the participants argued that these applications should be included because of students' interest in technology. T8 provided an example of this:

"When they are told to shoot a movie, make a documentary, they can enjoy it more. So they want to actively use technology already." (T8).

Additionally, T9 declared that she communicated with the students through social media tools. She thought this method was preferred by students and is more practical: "*I can sometimes, for example, we talk on WhatsApp. Sometimes there are people communicating on Facebook, because children can reach me whenever they want*." In addition, T8 stated students work as a data source to estimate their abilities and interests by collecting documents related to the activities they performed. Moreover, she stated that if it were possible to keep these documents within a technological environment, her work would be easier.

"And I have a portfolio of each child, so I also file the feedback about each activity. This makes my job easier. I can convert the drawings of children into photographs and file them electronically."

Technology perceptions

The participants' perceptions of the concept of technology during the situation analysis process were examined. They indicated advanced technological elements – such as computers, sensors, mobile phones, and social media tools – were at the forefront of technology perceptions. However, educational and instructional technology examples were also included. The codes related to the technology-perception theme are given in Table 3, and the codes are explained with quotations.

Table 3. Technology perceptions sub-theme and codes

Sub-theme	Codes
Technology perceptions	Hardware elements
	Educational and instructional technologies
	A facilitating product and tool

As shown in Table 3, the participants' technology perceptions were associated with hardware elements and educational technologies. In addition, they structured them around the tools they used extensively in daily life. For example, T2 stated that "*For example, computers, phones. I think it is technology. For example, drones are common lately. For example, smart doors, sensors… "* Another finding regarding the technology perceptions of the participants was related to the instructional technologies. In the interviews, some participants concentrated on the materials and environments used in the course. For instance, T1 stated that, "*Of course, when I say technology, there is technology in science education, mostly in the sense of molecular biology."* T6 described it as an auxiliary tool or product to meet the problems of daily life, avoiding specific examples of technology. "*The concept of technology is a tool, a machine, to facilitate the lesson for me. A machine that I can support children during the lesson."*(T6). The participants also presented examples of technological tools and applications used for educational purposes. For example, T8 commented: "*There are electronic devices that I use in education. We use the smart board, we use computers, we use the tablets."*

Importance of Using Technology for Gifted Students' Education

Participants thought that the use of technology was necessary for gifted education. They explained that their opinions were based on the characteristics of students, the shortcomings they experienced, their expectations, and their views about the areas they needed. The codes related to the importance of using technology for gifted students' education are presented in Table 4. Examples of the explanations regarding the opinions are discussed below.

Table 4. Importance of using technology for gifted students' education sub-theme and codes

Sub-theme	Codes
Importance of using technology for gifted students' education	Students' interest
	Using in the project process
	Development of high-level skills
	Academic acceleration and time savings

Some participants stated that technology is an essential element in gifted education. In addition, they reported feeling insufficiency in meeting their students' interest and curiosity about technology. For example, T9 lacked technical competence and explained that "*They usually like and are interested. So the technology for them is informatics, computers. There are very good ones. There are better ones than me. There are those who design games, for example*."

In addition, some participants asserted that they used technology at various stages of projects in gifted education. They mentioned that the tools could be used in the research process of the project and as well as in the stages of data acquisition and interpretation. For example, T6 stated,

"*While children are working, they can instantly record data, take pictures, etcetera with applications. I think it is beneficial to record the works instantly*." (T6)

Furthermore, they stated that the use of technology by gifted students would help them to develop skills such as creativity, making a new product, and problem solving because of their in-depth learning motivation and interest. The participants gave examples. For instance, T2 explained that

"*We got the idea of creativity that we should actually capture by showing these kids a small application of technology. We might explain in a period or in three weeks of a month."*

Additionally, it was argued that using technology in the education of gifted would speed up the teaching process and save time. It would also enrich the teaching by providing opportunities for diverse study. An example of this situation is given below.

"*The child may learn the subject in an hour that is taught in a certain period, for example it normally take three weeks or a month."(*T2)

Findings of need analysis

It was comprehended that the participants were not satisfied with their technology proficiency and felt the need for improvement in this area. They stated that they might have difficulty catering to students because of rapid changes in technology. They indicated that it was essential to provide technology-based training and learn innovative technologies such as Web 2.0 applications, coding, robotics, and mobile applications. Besides, they addressed the difficulties in adopting technology to promote its use. Their explanations indicated that the most focused-on issues were physical facilities and working with cooperation. The themes from the interviews are shown below in Figure 3.

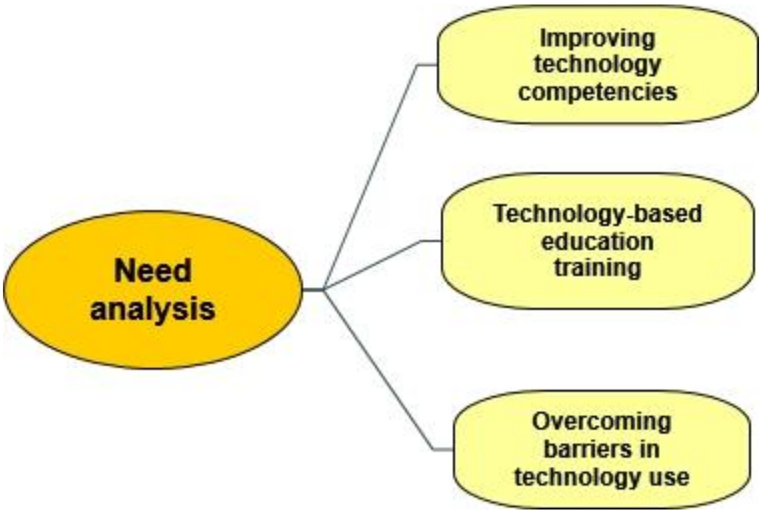

Figure 3. Sub-themes gathered at the need analysis theme

Improving technology competencies

In the interviews, most participants emphasized that they felt inadequate about knowing, using, and applying new technologies. Four of the 12 participants stated that they were at a reasonable level of technical competence. In contrast, eight participants perceived themselves as below the intermediate level or insufficient. They indicated that they lagged behind students because of the rapid technological change. They wanted to use educational applications or tools in their lessons and felt their work would be easier or that a more efficient learning environment would be created. Some relevant comments are provided below.

"Unfortunately, I'm still not [good] enough. Individually, especially in design… I want to design experiments, design videos and make videos myself, but I cannot. I am very lacking in those matters." (T3)

"I want to learn a little bit about augmented reality. There are augmented reality applications that I sometimes need and dream about to design applications. I want to get training in this field to design them." (T9)

Technology-Based Education Training

Although the participants acknowledged the necessity of technology in the education of gifted children, most stated they felt inadequate in this area and were open to self-improvement. They emphasized the requirement to use technology in gifted education. According to the codes, their opinions about technology-based education are shown in Table 5.

Table 5. Technology-based education training sub-theme and codes

Sub-theme	Codes
Technology-based education training	Web 2.0 tools
	Robotics and coding applications
	Mobile applications
	3D printers

As evident from Table 5, participants indicated that they needed technology-based training. They listed their expectations for the content of such training and their views about the fields and subjects they wanted to learn. In this context, innovative technology applications – such as Web 2.0 applications, robotics, coding, mobile application content and 3D printers – were included and they wanted to participate in such content. Example of it is given below.

"If I tell them, can we animate this experiment with you? Those who can do it and those who wish will emerge. I am trying to catch up with the times. There are some things I don't know, things I want to learn." (T9)

Ultimately, the participants preferred to use videos and content that could be placed on the smartboard at various stages of their lessons. Their perceptions about technology were related to educational and hardware tools, and they mentioned new technology applications. However, most participants felt shortcomings, especially about the use of new educational technologies (such as Web 2.0 tools, software, coding, robotics, and 3D technologies). They also added that the desire to participate because of feeling more behind than children came to the fore. However, especially in the case of training about the use of new educational technologies (such as Web 2.0 tools, software, coding, robotics, and 3D technologies), most participants indicated that feeling shortcomings and desired to participate.

Overcoming barriers in technology use

According to the participants there were some difficulties with using technology. Participants stated that although technology was essential in the education of the gifted, they experienced integration problems in their lessons. They added that the technology would become more functional if these problems were eliminated. The codes related to the sub-theme of overcoming barriers in technology use are given in Table 6 and explained below.

Table 6. Overcoming barriers in technology use sub-theme and codes

Sub-theme	Codes
	Enhancing hardware deficiencies
Overcoming barriers in technology use	Holding interdisciplinary practices

As evident in Table 6, the participants reported that one of the most significant problems in using technology in their lessons was hardware problems. The most frequently mentioned factors regarding hardware were inadequacies in internet infrastructure, the lack of a smart-board, and the lack of a computer lab or computers. For example, T2 said, "*The computers where I work are very old. It is very difficult to use. We have to use the laptops and projection devices provided to us in schools.*"

The participants mentioned that they could not use these tools effectively because they did not have enough equipment. Furthermore, the participants highlighted the importance of interdisciplinary studies in the functionality of technology use. The PD program they participated in made it apparent cooperation with information technologies should be considered as a common working area rather than specific to one field. T9 stated; "*They gave training on augmented reality applications. I learned from a friend; it was very difficult to design that application. Maybe we can make interdisciplinary study*."

This study determined that the participants would like to participate in technology-based training and overcome their weaknesses. Furthermore, they thought that using technological tools and applications was beneficial when the hardware problems were overcome. Therefore, it was planned that a technology-based program based on the ASSURE model with Web 2.0 tools related to SSI topics. Web 2.0 tools are suitable for use by gifted to provide flexibility, usability, interaction, and content creation opportunities. The program was conducted in eight sessions using nine different tools. The data from the pilot study comprising these sessions are presented below.

Findings of the pilot study

The participants in the pilot study were aware of innovative technologies, but felt they lacked a way of successfully integrating them into their lessons. It was understood that they could be used for enrichment, especially when planning activities, or to support the project process. For example, P3 stated that "*I think children can handle the poster preparation part from there, I think children can undertake the preparation of this web page….*" Also, the interviews indicated that the teachers wanted to participate in a PD program enriched with technology and they were satisfied with the process they went through. Views from the participant group are presented in Table 7.

Table 7. Pilot study's themes and codes

Themes	Codes
Positive opinions	Ensuring active participation
	Appealing to many sensory organs
	Attracting attention
	Easiness on evaluation
	Quick feedback opportunity
	Interactive applications
Negative opinions	Hardware deficiencies
	Lack of time

Table 7 shows that the participants in the pilot study talked about many advantages and their opinions were positive after the developed program. However, the hardware deficiencies and the timing of implementation were perceived negatively by some participants. For example, P2 stated, "*Yes, they are very interesting. Web 2.0 tools will be ideal for gifted students. I think they will get very positive results by attracting their attention.*" Similarly, P2 commented negatively that *"We had a little trouble about a single process, so we had to use the time, so if we could spread this over a little more time ...*"

Discussion and Conclusions

In some studies, there is an invalid belief that gifted students can teach themselves to use technology because of their high potential (Öngöz & Aksoy, 2015). Although technology is recommended to be used as an enrichment activity by specialists for gifted students (Renzulli & Reis, 2007) there is a lack of practical studies (Bangel, et al., 2006; 2010; Reid & Horváthová, 2016) is notably limited. Besides, technology research has generally addressed attitudes, senses, and perceptions. (Ağaoğlu & Metin, 2015; Kahveci, 2010; Yun et al., 2011; Shaunessy, 2007).

The need for education for the teachers of gifted students by interviewing the teachers working at SACs was examined in the current study. The interviews conducted with teachers of gifted students showed that their opinions were mainly based on explaining the status of the current situation of technology use. They also revealed their needs in terms of technology enhancement in their classes and expectations from a technology-based PD program. Teachers needed a technology-based PD program similar to the study of Periathiruvadi & Rinn (2012). According to the findings of the situation analysis, the current status was the inadequacy of the technology infrastructure was that teachers did not know how to use the many changing and rapidly updated technological applications (Besnoy et al., 2012; Buckenmeyer, 2010) and incompetence in integrating technology into their lessons. It was concluded that the technology applications used were mainly at a basic level and were preferred for providing visualizations or repetition, for lecturing, or web search.

One of the need analysis findings, the participants' emphasized rapid technological changes and their feeling of lagging behind the students. Moreover, they expressed that they needed environments and situations where they could improve themselves. Similarly, Lee & Jin (2015) reported that investigating the technology competencies of teachers working with gifted students is crucial to increasing the ICT-related abilities of gifted students. However, they mentioned that ICT-related activities in education programs are limited to the basic level. Also, they found that teachers used to collect information or make visual presentations for purposes such as searching the internet. Although teachers of gifted students are aware of technologies, they choose the ones they use from a limited range of options (McGuire, 2012).

Another finding of the need analysis, it is understood that the participants in this study emphasized a technology-based education and the improvement of physical facilities to develop their technical competence. Besnoy (2007) stated that 81% of teachers working with gifted students received fewer than ten hours of PD on integrating technology into teaching. This is consistent with the finding of Lambert & Lane (2004) that teachers need comprehensive and continuous PD to increase their self-confidence and ability to integrate technology into the teaching process. Such training should have consequences for students' performance. Mobile technologies and applications and devices have rapid development and frequent updates. Teachers need learning opportunities that can develop at a similar rate to keep teachers abreast of these technologies and how to use them effectively in teaching (Jones & Dexter, 2014).

One of the findings of the need analysis process was the participants emphasized the importance of using technology for gifted students' education. They stated that a technology-based training should be prepared in this context to meet the various needs of students. It was also determined that they thought they could use the learning environment more efficiently by saving time and providing academic acceleration via technology. This indication was similar to the participants' opinions in the pilot study. The participants' opinions were positive regarding using innovative technological tools (such as Web 2.0 tools, robotics, coding, and 3D printer training) and their willingness to learn these applications in the pilot study. Chen et al. (2013), made similar implications as an urgent need for more innovative practices in using technology in the education of gifted people. They also emphasized that more systematic and in-depth research is needed to advance this field. Moreover, Torkar et al. (2019) indicate that science and technology are poorly represented in gifted students' overall selection of elective school subjects in Slovenian basic education.

Another important finding of the pilot study was that the participants perceived as the PD program practices would support the development of high-level skills in gifted students and attract their attention and motivation (Zimlich, 2016). Similarly, Batanero et al. (2019) emphasized that among the best practices developed are those involving Web 2.0 tools because of their variety of content and the creative and flexible resources they offer. They also mentioned that e-learning courses and social networks to facilitate interaction with peers and improve the learning processes could be highly useful. However, they complained about hardware deficiencies and a lack of time in the pilot study process.

To conclude, teacher education should be carried out in line with the requirements of 21st-century skills in studies related to the PD of teachers, and this training should be organized to develop skills for gifted students. The technology-based PD programs should be applied to improve their knowledge and provide the help they need. The participants emphasized the provision and importance of environments for teaching innovative technological applications and tools for producing projects. This study showed that the teachers needed technology-supported education and felt lacking in this area. The PD program implemented in the ASSURE instructional design model, which included Web 2.0 tools related to SSI topics, was assessed as applicable and considered these tools to enrich their lessons or useful for integration into project processes. This model can be used widely within teacher training. Also, technology can be used to meet the needs of teachers in online PD contexts. The model implemented in this study can enrich gifted education and be used in other courses by differentiating it. Furthermore, since the SSIs forming the basis were from interdisciplinary fields, they can be integrated into the education of future teachers of gifted students. Online learning opportunities should be expanded to include working with gifted students and for the PD of teachers. Little & Housand (2011) declared that various organizations, schools, school systems, and governments could use online PD courses, webinars, network meetings and communication tools. According to participants' opinions, students should be allowed to take classes from faculty members working in related departments – such as computer and instructional technology education, computer engineering, and software engineering. It is recommended to organize individual or group training on general technologies and ensure that teachers benefit from this training.

Based on the findings of the study, it is recommended to carry out investigations to benefit from many Web 2.0 tools that can be used to evaluate teachers' technological abilities and efficiencies in other ways and pursue them according to their developmental characteristics within other studies. It is suggested that in areas such as robotics, coding, and 3D- printers training for teachers of gifted students, in cooperation with universities should be held. The Web 2.0 tools used in the program can be used in activities in and out of school, and resources should be provided with parent and school support to support gifted students' achievement. Improving the technological competence of teachers, planning technology-based training, and eliminating difficulties in technology usage should be achieved. It is also suggested that teachers prepare lesson plans based on the ASSURE model and make implementations for teaching, peer assessment, social interaction, and feedback to follow gifted students' interests and skills with appropriate Web 2.0 tools. Through other studies, it is suggested to make long-term plans so that the studies with teachers fully reflect the development process and obtain more detailed information about the situation and difficulties experienced by conducting longitudinal studies. Conducting and disseminating applications for teachers in different fields and carrying out wide-ranging applications can be proposed.

Note: Author/s declare presence of Ethics Statements that needed for ethical conduct of research using human subjects.

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