Technology-based professional development program: Experiences of science teachers

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Article Info	Abstract
	This study aimed to evaluate science teachers of gifted students who participated in a technology-based professional development program, how could be used the applications they learned in the program, and their use area for the gifted education. The case study was carried out with ten science teachers of gifted students. The data were gathered via interviews and open-ended forms and analyzed with the content analysis method. The findings showed that teachers stated that the program was beneficial for their professional development because of increasing the use of digital technology tools and their awareness of the opportunities for gifted education. Also, they became aware of using the applications for enrichment, supporting the class, evaluating, and integrating into the project-based learning process in science lessons. Another finding was that participants' evaluations of the program offered the advantage of providing communication and mentoring opportunities with the university and contributing to their professional development.

1. Introduction

Teacher education is a crucial element of a successful educational process. There is a significant amount of research into professional development programs for general education, although research regarding teachers of gifted students is minimal (Besnoy et al., 2012; Mofield, 2020; Reid & Horváthová, 2016; Shaunessy, 2007). For getting successful outcomes in gifted students' education, it is fundamental to examine teacher education and conduct studies in this area (Seredina et al., 2016). Teachers of gifted students should adopt rich instructional methods and techniques in learning environments. One way of providing an effective teaching environment is by effectively enriching the teaching environment using technology. Because technology allows students to share their ideas beyond the classroom walls, collaborate on research, explore learning opportunities, and improve self-regulation (Zimlich, 2017). Technology-enhanced activities have great potential that can be useful in the development and application of cognitive abilities of the students, such as questioning, discussing, and exploring by using technology (Robinson et al., 2014). As technology is a learning tool for improving learning processes by focusing primarily on learning in the learning-centered approach, it should be adapted in line with the needs of students and teachers by using appropriate methods and pedagogical practices (Dolenc & Abersek, 2015; Potts & Potts, 2017; Ali & Alrayes, 2019). Thus, using technology to support and enrich teaching topics and teachers' training by creating content would be favorable.

However, teachers might face difficulties integrating technology and its' sustainability because of time, unfamiliarity with the applications, and conditions specific to situations. For instance, Lee & Jin (2015) examined the technology competencies of teachers working with gifted students, and they found that ICT-related activities in current education programs for gifted students were limited to the basic level. Arslan & Coştu (2021) revealed that teachers perceived challenges as creating the materials, time-consuming use, lack of technology, and access. Another problem is integrating technology because of teachers' technological competencies and insufficiencies in existing technologies (Dag, 2016; Tatli & Akbulut, 2017). Similarly, one gap which teachers lack is related to the use and integration of technology in a class situation (Barak, 2017; Voogt & McKenney, 2017).

There is limited research on technology training for teachers of gifted students that explores how teachers can be guided and supported in integrating technology into their learning environment (Periathiruvadi & Rinn, 2012). So, it is crucial to provide opportunities for enriching and differentiating the educational environment of gifted students by training teachers of such students and supporting their professional development. The teachers' use of information technology is a critical issue affecting the role of information technology in the education of gifted students (Shaunessy, 2007). Little & Housand (2011) emphasized that online tools could be used effectively to communicate teachers with colleagues working in different locations, provide professional learning experiences, and support their professional development. They also highlighted the importance of appropriate content, active participation, constant attention, and administrative support and compliance to be effective. Thus, to increase the competence level of teachers, practical training should be organized to examine and improve their cognitive and psychomotor skills, along with examining the affective dimension that measures perception or attitude.

Apart from that, studies about using technology with gifted students are primarily descriptive studies; it should be given to empirical research on newly emerging Web 2.0 technologies and their effectiveness regarding gifted students (Periathiruvadi & Rinn, 2012). There are also several other studies showing that Web 2.0 technologies can create opportunities for the education of gifted students and that further research is needed on this subject. Using Web 2.0 technologies is deemed necessary, as they can be used for educational purposes, including effective participation, content creation and updates, and communication with other users (Baran & Ata, 2013). Web 2.0 tools serve a wide variety of content and creative and flexible resources they offer because e-learning courses and social networks that facilitate interaction with peers in different places in such a way as to improve the learning process could be highly beneficial (Batanero et al., 2019). Web 2.0 technologies allow students to create original products for audiences to publish and share their work on various media, mentorship, and collaboration (Zimlich, 2016).

In this regard, this study aimed to ascertain the opinions of science teachers (elementary science, physics, chemistry, biology) who participated in a technology-based professional development program for enrichment of the education of gifted students and how they used the applications. The applications that were used in the study were Web 2.0 tools. It was applied within a professional development research project aimed at integrating technology into the education of gifted students and improving the level of technology usage among the teachers. The participants were teachers who taught at Science and Arts Education Centers (SACs). SACs are institutions that support the education of gifted children on weekdays after school and on weekends. A pilot study was carried out within the project with another participant group of science teachers who took part in the technology-based professional development program based on the ASSURE model. This study was conducted to provide a more in-depth examination of the perceived effects of the implementation. In this context, the study sought answers to the following questions:

1-What are the opinions of the participants regarding the technology-based professional development program?

2-What are the participants' opinions about using the applications introduced in the professional development program in the education of gifted students?

2. Literature

2.1. Professional Development in the Use of Technology

Teachers are expected to adapt to the rapid changes and the developing world and adapt to the technology used extensively by the new generation (Spiteri & Chang Rundgren, 2020). When technology is incorporated into teaching methods, it can improve learning, expand knowledge, improve higher-order thinking skills, and carry students beyond learning through memorization (Giavrimis et al., 2011). The studies implemented to enhance teachers' technology efficiencies mostly reveal positive outcomes in the literature. For example, Thurm & Barzel (2020) found that the technology-supported professional development program for mathematics teachers effectively influenced teachers' beliefs about technology. Also, they determined that the frequency of technology use increased during the professional development program in the experimental group. Martin et al. (2010) implemented technology in their professional development program based on a teaching approach that uses inquiry-based learning. They found positive outcomes by student success and impact on lesson plans. In the program based on the Align-Align-Integrate (A2I) model, a student-centered teaching strategy supported by ICT and active learning strategies was applied by Murthy et al. (2015). The results showed that participants had high perceptions of their learning and had intentions to use the knowledge and skills in their classes.

Matzen & Edmund (2007) developed a professional development program for teachers using technology in their classrooms based on constructive instruction. By the results, the participants increased their use of technology in ways seen as more constructivist and broader. Another study was conducted by Koh et al. (2017) to develop teachers' technological pedagogical content knowledge professional development process and found positive effects on teachers' confidence in Technological Pedagogical Content Knowledge (TPACK) knowledge.

There are different types of studies to enhance teachers' technology use. Despite other models of technology integration, it was used ASSURE model-based, which is suitable for technology enrichment thanks to its structure of a straightforward implementation; since the implementation was limited to a few hours, the activities were planned in an individually structured. In addition, the ASSURE model provides a clear framework for how to plan a technology-focused lesson (Kim & Downey, 2016).

2.2. The ASSURE Model

The ASSURE model is a popular education model in that teachers can integrate technology into the teaching lesson (Shelly et al., 2012). This model has a structure that guides teachers in following the step-by-step process of using technology effectively in the classroom and its usability in different subject areas (Duman, 2015). The ASSURE model consists of the initials of the stages that make up the model. It is expressed as a practical and easy-to-apply design model used to integrate technology into the classroom (Kim & Downey, 2016).

The ASSURE model includes the basic components and stages of instructional design include and the phases of:

- Analyze of learners
- State objectives
- Select instructional methods
- Utilize media and materials
- Require learner participation

- Evaluate and revise (Heinich et al., 2002; Kim & Downey, 2016; Smaldino et al.,2005; Smaldino et al., 2008).

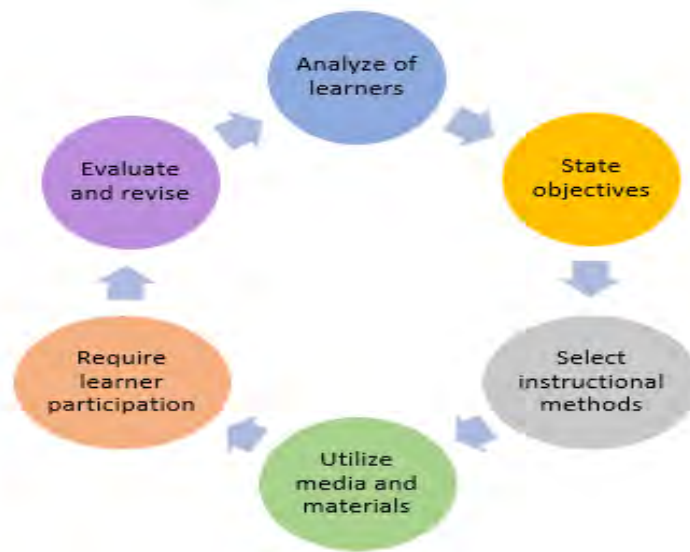The phases of the ASSURE model are shown in Figure 1 below.

Fig. 1. The stages of the ASSURE model

3. Methodology

3.1. Research model

The case study method was used in this research. A case study is defined as examining a limited system over time through detailed, in-depth data collection that includes multiple sources of information (Creswell, 2018; Stake, 1995; Yin, 1981). In this study, the situation examined was applying for a professional development program in line with the needs of science teachers working at SACs. It was conducted in semi-structured interviews to identify the participants' opinions about the professional development program and the use of the applications in lessons. The interview findings were enriched with open-ended forms to increase reliability. Besides, detailed and intense descriptions were used as a measure of validity. The number and characteristics of the participants, how they were selected, the data collection tools, and analysis techniques used in the research were explained in detail. In order to increase credibility, demographic characteristics such as the number of participants participating in the research process, their fields, and the duration of their employment at SACs were explained.

3.2. Participants

The purposeful sampling method was used in the selection of the participants. The purposeful sampling method can include any strategy, including criterion, extreme/deviant case/ intensity, homogeneous, typical case (Patton, 2014). Participants were elementary science, physics, chemistry, and biology teachers who worked in SAC fields that provide education and enrichment programs for gifted students. The participants were selected purposefully because their common fields were appropriate science areas, and familiarities with the socio-scientific issues (SSI) were suitable for the interdisciplinary approach exercise. These teachers conduct hands-on enrichment activities and project-based exercises with gifted students at SACs. The characteristics of the participants are indicated in Table 1.

Table 1.

The characteristics of the participants

Participants	Gender	Professional seniority (years)	Employment at SACs (years)
T1	Female	14	8
T2	Female	12	3
T3	Male	10	4
T4	Female	8	2
T5	Female	8	1
T6	Male	19	10
T7	Male	20	2
T8	Male	18	5
T9	Female	22	5
T10	Male	11	1

As shown in Table 1, the participants were ten teachers, five of them were female, and five were male. Seven of them are at the postgraduate education level, and teaching experience periods were at least eight years to 22 years. Being teachers of gifted students', the durations changed between one year to ten years at the most.

3.3. Data Collection Tools

3.3.1.Interviews

Denzin (1989) argues that a single method will not illuminate the problem of ensuring credibility with triangulation. For this reason, by diversifying the data sources, the situation was described in more detail. The interviews were conducted to examine the participants' views about the professional development program and reveal how the applications can be used in the education of gifted students. An open-ended form containing the participants' opinions regarding the applications used within the professional development program was applied. Detailed information about these tools is provided below.

The researchers prepared the interview questions, and they were reviewed by two experts who have a Ph.D. in science education and one expert who has a Ph.D. in gifted education. Interviews took approximately 45 minutes. The interviews involved evaluation questions about the implementation process, questions about the applications used, opinions about the applications used in their lessons, and suggestions about the negative situations or insufficiencies they experienced.

3.3.2. Open-ended forms

The open-ended forms were prepared to provide feedback for each application and applied at the end of the study. The open-ended forms were used to deepen the participants' perceptions regarding how the applications could be used in the education of gifted students. Some samples from the form are shown in Figure 2 below.

Considering your experiences with the applications used during the training below, please indicate your views on the use of the application in your lessons.

Sample of Activities	Tools and content	Strengths	Weaknesses	How to use in terms of education of gifted students
Activity 1	**Powtoon** (Animation making related to GMOs)			
Activity 2	**Bubbl.us** (Mind mapping related to nuclear power plants)			
Activity 3	**Padlet** (Preparing a digital board on climate change)			

Fig. 2. Samples of open-ended forms

3.4. Context of the study

This research was implemented in SACs established to support the education of gifted students. The aim was for the participants to integrate technology into their classes for gifted students. Within the program's framework implemented in the SACs, students are divided into groups regarding their interests. After completing the student-oriented activities related to their levels, they participate in original project preparation activities involving interdisciplinary work. As part of this process, they perform actions based on problem-solving and engage in project-based teaching studies with elementary science, physics, chemistry, and biology teachers.

In this study, eight sample practices involving socio-scientific issues (SSI) based on Web 2.0 tools and mobile applications, and innovative new technologies were designed for the activities carried out by the science teachers in their lessons. These activities took place in eight separate sessions as an enrichment activity. At the beginning of the process, a session was held to give the participants information on the ASSURE model, forming the conceptual basis of the technology-based enrichment activities. The Web 2.0 tools used were introduced to the participants during each session activity, and their use was shown with examples. In addition, by creating an environment involving research and discussion about SSI in question, they were asked to develop a design that reflected their views regarding the SSI. In the eight sessions, it was introduced nine different applications to the participants, and the researcher provided support about the problems related to the applications being used in creating their activities. The participants stored the practices they made by displaying them on a content management system. Each participant experienced preparing an enrichment activity by using the Web 2.0 tools. The topics of SSI are shown in Figure 3 below.
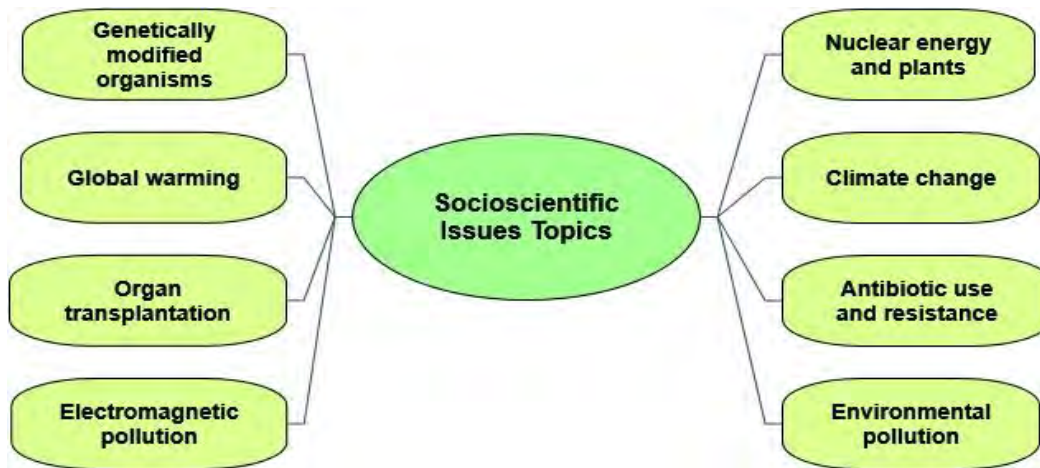
Fig 3. The SSI topics used with various Web 2.0 tools

As shown in Figure 3, different socio-scientific issues were discussed in each session. Recent news, articles, and videos about the SSI dealt with during the sessions were shared electronically. Besides, it was provided with an opportunity to discuss the subject before the technology activity, and they were allowed to do research. The sessions were audio-recorded by one of the researchers. The content created by using the Web 2.0 tools was saved electronically by the participants. Interviews were carried out with all the participants after the implementations. The Web 2.0 tools used during the implementations is shown in Figure 4.
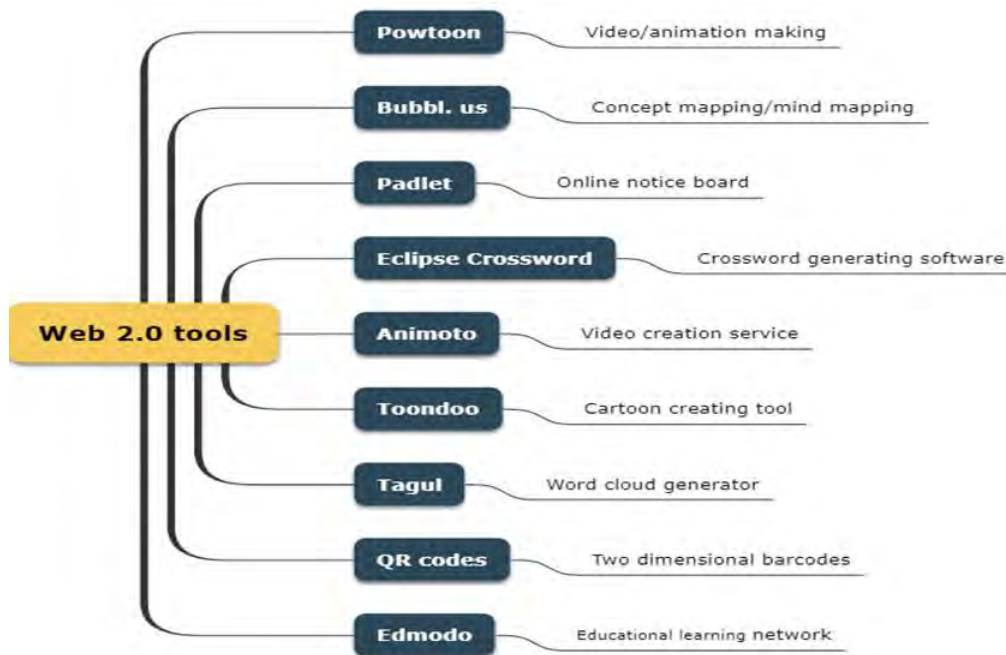

Fig 4. The Web 2.0 tools used in the implementations

As shown in Figure 4, the participants used all the tools with an SSI topic and created authentic materials. After the pilot study was completed within another research, the main study phase was started at SACs in two different cities between June and September 2019. When implementation was carried out, like in the pilot study, open-ended forms were used to ask about each of the tools used, and semi-structured interviews were used to evaluate the process.

3.5. Structure of the program

An example of one of the activities, including the SSI subjects in the sessions held in the professional development program based on the ASSURE model, is presented below.

The subject of the activity: Discussing genetically modified organisms (GMO) with Web 2.0 applications

Purpose of the event: It is aimed to reveal the concepts related to the effects of GMO production on public health, economy and social life, and the environment, to present as many different ideas as possible on this subject, and to share the views as an animation or video

Duration: 2 hours (120 minutes)

Materials: Computers with an internet connection, a sound system, and files containing images and documents related to the subject

The steps:

- Analyze learners:

At analyze the learners' stage, to reveal the preliminary knowledge of the teachers about GMOs, it was asked questions about GMOs and their views of following the current developments on the subject, and they were asked to explain through a sample situation. After determining knowledge levels about GMOs, discussions were made about the purpose of GMOs, the application situation in the world, and why GMOs are needed. Based on this available information, they were asked to prepare an animation by examining GMOs in public health, economic, and environmental dimensions. After that, it was introduced to the Web 2.0 application Powtoon about its use and features.

- State the objectives:

At this stage, it was asked from teachers to create:

a) Examples of GMO products and the effects of GMO use between public health and the economy,

b) Effects of GMO use on the environment

They were expected to reflect their views on GMOs through a multimedia design using Powtoon.

- Selection of method, medium, and materials:

Method: Technology-based science teaching, discussion, question and answer techniques were used.

Environment: Newspaper news, statistical information, various visuals, and websites were presented.

Materials: Powtoon was used for multimedia design in which views on GMOs were expressed.

- Utilize media and materials:

 Visual materials containing information about the GMOs to be used, newspaper news, case studies, and statistical data were gathered in a sample file. The study environment was optimized by checking the Internet and the relevant online resources used in the study.

- Require learner participation:

 During the process, discussions were carried out by determining the participants' preliminary information about GMOs. After that, they were given some time to examine the work file for GMO-related resource creation and create their interpretations. They used Powtoon to share their opinions and created the animation individually. The interface with ready-made elements related to the features of the program and the design of the multimedia was introduced, and information was given about the features such as adding visuals, audio, and video.

- Evaluate and revise:

The content of the multimedia material created about GMOs was evaluated according to the level of coverage of the activity's objectives. In this context, teachers were asked to share the materials they prepared on Edmodo, a social learning platform, to enable each other to see the content they shared. The participants involved in the content shared on the Edmodo platform were engaged in an interactive process and evaluated each other's work by exchanging ideas regarding the multiplicity, diversity, and integration of the steps taken in the activities.

3.6. Data Analysis

The interviews were audio-recorded using the recording feature of the researcher's mobile phone and then transcribed. The researchers coded the data gathered from the interviews within the triangulation and used the content analysis method. When the codes were compared and calculated the Cohen's Kappa value, there was an 85% similarity. After that, the researchers completed the coding and presented it by combining the codes under specific themes. Data identified through interviews, the evaluation of the professional development program, and how the technology was used in lessons for gifted students were coded, and the final version of the relevant themes and codes are presented in the findings section.

The qualitative data obtained through open-ended forms were transferred to NVivo 12 software for analysis. The data obtained from the open-ended forms were examined and reported on in the findings section. Moreover, the evaluation of the opinions about each tool used in the implementation was given under separate headings by creating codes and themes. After that, the results obtained from the open-ended forms and semi-structured interviews related to integrating the applications into the lesson were compared and presented together.

4. Results

The data obtained from the interviews involving 10 participants were coded under five themes and sub-themes. Several categories were created from the interview responses, and these categories were used to develop themes. The themes that emerged from the data related are (a) the lesson process, (b) the project process, (c) the advantages offered by using the applications in lessons, (d) the disadvantages that may arise by using applications in classes (e) the opinions about the contributions of the professional development program. The themes were then examined to understand whether they supported a particular assertion. These three assertions and evidence regarding them are presented in the following section. To protect the anonymity of the participants regarding the interview results, they were symbolized by the letter "T" and numbers between 1 and 10. The themes gathered are shown in Figure 5.
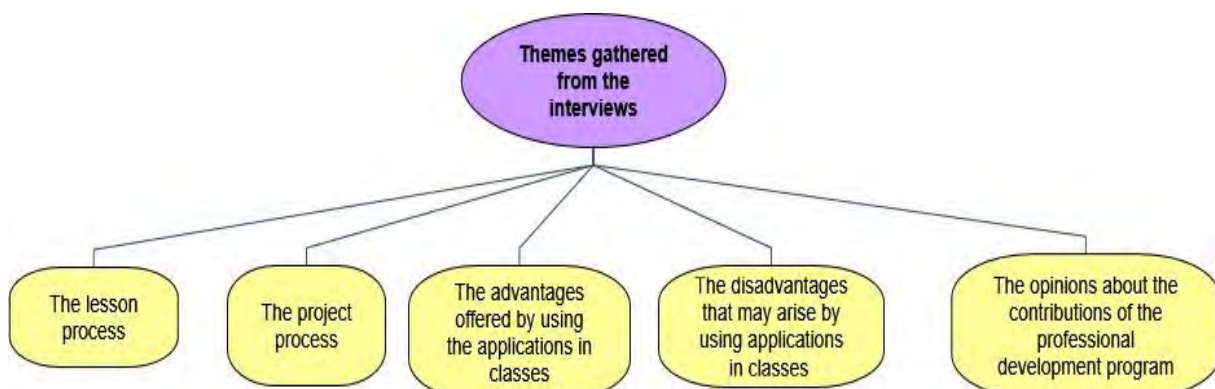

Fig 5. Themes from interview findings

4.1. Assertion 1. Participants realized that the professional development program provided many benefits in terms of the education of gifted students

The participants emphasized that the applications they used in the professional development program offered them the opportunity to use them in many areas regarding the education of students, such as enriching the teaching process, using them in the project process, and facilitating individualized teaching. In addition, they asserted that the applications provided advantages such as the possibility of setting up an individual training file and having detailed information about individual students, getting quick feedback from students, and establishing secure communication. For example, T2 stated, *"I can use it during the lesson. By using games… In other words, we can diversify them at each stage according to the nature of the subject. I am sure that the lesson will enrich both the students and me with these different methods."*

Similarly, *"Animations already visualize and set things in motion. They may provide permanent learning regarding the subject. By finding the photo frames and animating them, it can be crucial in our lessons."* was indicated by T1.

Moreover, since gifted students had to engage in project-oriented activities, the participants expressed that they should integrate these applications into that process. They declared that the applications could be used to prepare posters, work together during the lesson, be ready for the class, and test at the end.

> *"For example, we can use it to prepare a poster because... if we need to prepare a poster for our work, we go and have it done by the advertisers, but normally we can prepare our poster". (T3).*

According to the participants, it is essential for the students working on the project to share their experiences about the process, collaborate, and interact with each other. In contrast, the projects are being carried out. In this context, there were opinions expressed that the group would remain dynamic when engaging in the project process when there were tools for sharing this process.

> *"In the sense of following the steps they make in the project process, sharing them, and establishing mutual interaction, some applications may attract the students' attention more. Edmodo was one of them"(T10).*

Some applications could be used in terms of the needs of the students and could help individual learning, was stated by T1 while interviews. For example, they said that QR codes could serve many purposes by differentiating the tasks according to the students or assignments according to individuals.

> *"… For example, the student can scan and solve a question, while another solves a different question. Moreover, I might send homework, let's say project work. The students can access different tasks by scanning the codes"* (T1)

They also expressed the view that was preparing paper-based files containing information about gifted students created an extra workload for them. It emerged as another finding that it could be convenient since it would be possible to structure and store the information, they get through some of the applications they used within the technology-based professional development program as a portfolio system. For example, T3 asserted the following about this situation:

> *"For documents, for example, collecting portfolio files always means a lot of paperwork, photocopies… For example, since these are on the computer, children can prepare see and evaluate them. We can store the answers and questions of the children as product files".*

In addition, T3 emphasized the importance of communicating with her students quickly and getting feedback. They thought some applications could be used for her lessons for various practical purposes, which would make her job more manageable.

"There are things where I can get students' feedback directly. For example, I assign research assignments to students every week. Edmodo, I am planning it in such a way as to get feedback, for example. They can send their research topics directly to me". (T3)

The participants thought that some tools they used could be used in the lessons to improve the students' creativity, which would make the lessons more fun and motivate the students. For example, this situation was brought up in a comment made about the digital cartoon-designing application.

"...having the kids prepare it is more effective for developing the kids' creativity because kids always like colorful, interesting pictures. And it will be more colorful if they make jokes or something related to the subject". (T1)

Like the results obtained from the interviews, it became apparent in the open-ended form when the participants stated their opinions about each application and expressed their opinions about the areas in which these tools can be used.
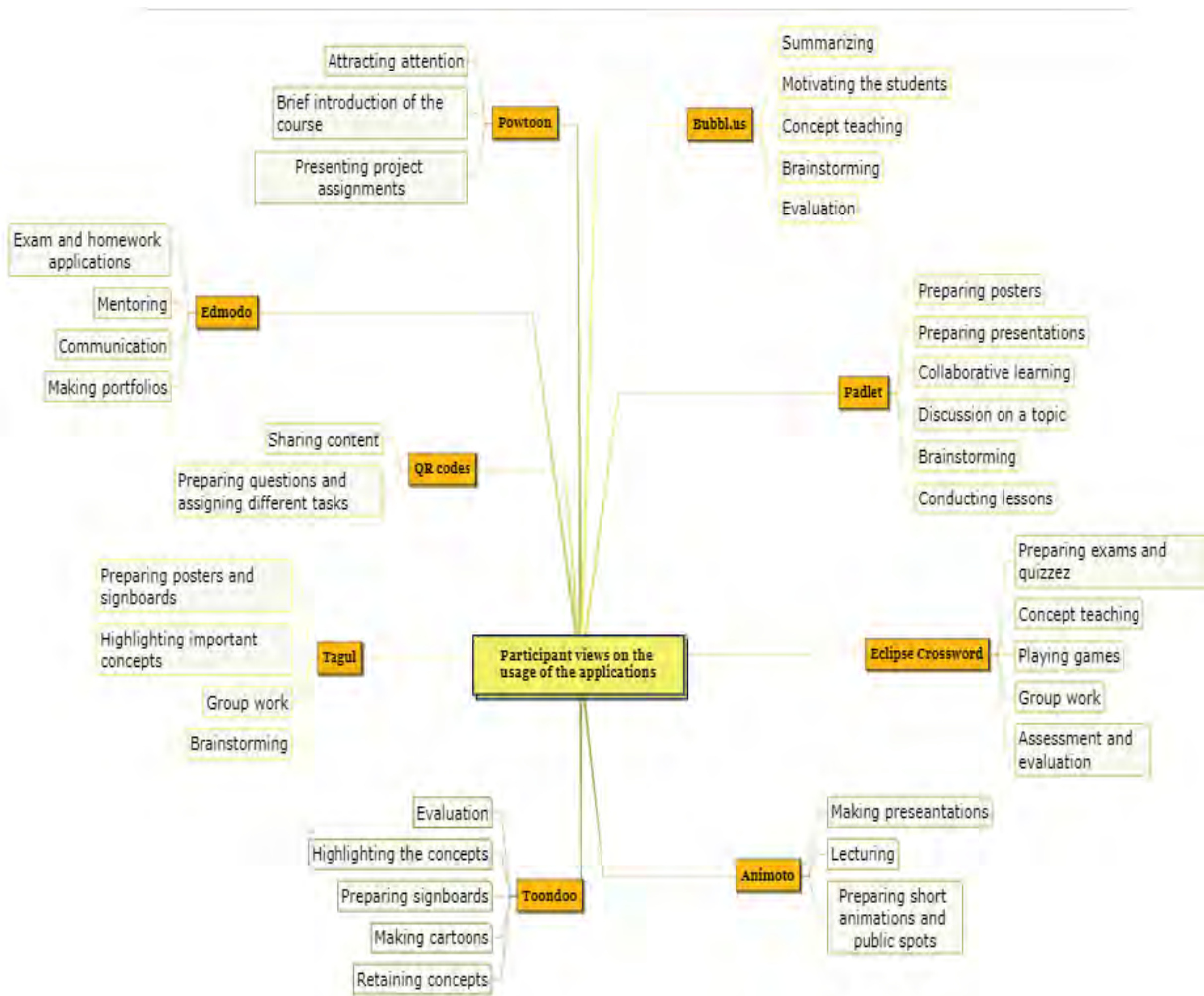

Fig. 6. Participants' views on the applications from open-ended forms

As shown in Figure 6, the participants thought that the applications could be used in many ways in the education of gifted students. They repeated their views about using them for projects, presentations, collaboration, communication, and portfolio creation. The interview and open-ended form findings showed that the applications served the purposes of being used to diversify various stages of the lessons in the education of the gifted students, such as creating a project and introducing and presenting a project.

It was also determined that the participants expressed those gifted students could work individually or in groups and develop an understanding, which could be used for communication, mentoring, and assessment.

4.2. Assertion 2. Participants perceived an increase in their level of technology use with the contribution of the professional development program to their professional competencies

The issue most emphasized by the participants regarding the implementation is that the program contributed to their professional development in teaching. In this context, they stated they were not familiar with most of the innovative technology applications. They stated that factors such as generation differences and age were influential in this situation and that the implementation provided helped to eliminate these effects. Thus, they were self-critical themselves up to date because of the rapid changes in technology. Besides, the participants evaluated the process as being influential and productive for themselves. The statements of the participants regarding these evaluations are as follows:

> *"Although the novice teachers are more involved in technology, the others are not that involved, but these kinds of things, these activities, the use of computers, following technology, close that gap of generation difference between the teachers, which is good"* (T7).

> *"I am very interested in these issues. However, I saw that there were many things that I missed. Well, I realized I needed to keep up a little bit more"* (T10).

In addition, another evaluation made by the participants regarding the implementation was related to the high level of interest and curiosity that gifted students have about requiring teachers to have a solid background to keep themselves up-to-date and achieve the required level. In this context, they referred to the benefits of their process in supporting students' levels and interests.

> *"Gifted students are also more curious and learn faster because they are a few steps ahead. That is why they know a lot about technology. We also need to have a good background in an area which they dominate. We need to keep our level higher"* (T4).

> *"So, children are more successful when technology helps with their goals. Yes, these kids are already keen on computers, and these Web 2.0 tools are also about using computers, so it is useful in learning physics"* (T7).

Another prominent point in the participants' evaluations about the implementation was that they expressed that this process created a connection between teachers and academics and was crucial in communicating the needs and demands of education when necessary. Additionally, they needed such training and expected its sustainability.

> *"Of course, with such a study, we are communicating with the academy, with academics like you. We consult you when we need it. You are a mentor for us"* (T5)

> *"New practical ways may be produced. We may miss these, on the one hand, so we should be in touch constantly. We always want to see our academics with us; we want to work together because we have seen that this is very useful, and we want to benefit from this"* (T8).

4.3. Assertion 3. Participants perceived some difficulties regarding the applications used in the professional development program

The participants indicated that there might be some negative situations concerning the applications they were introduced to and planned to use in their lessons and noted that some cases might hinder the process. The opinions of the participants regarding adverse conditions on using the applications are shown in Figure 7.
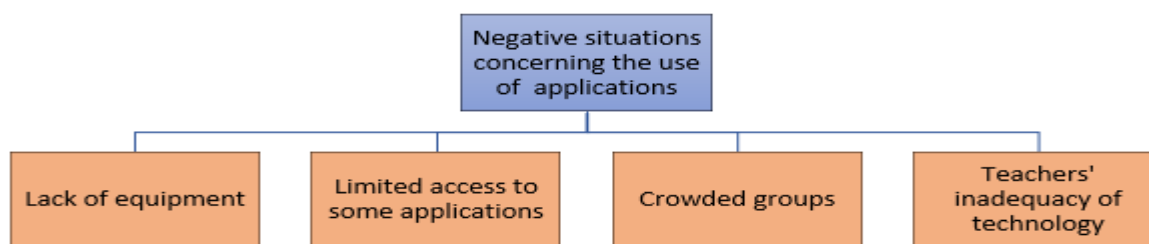

Fig. 7. Participants' views of negative situations concerning the use of applications

According to Figure 7, These adverse conditions were grouped under titles such as lack of equipment, limited access to some applications, problems stemming from students being in crowded groups, or teachers' inadequacy regarding technology. They frequently questioned the usefulness of the applications and their use for many purposes in the lessons. They also offered solutions regarding the negative aspects of using the applications. They offered suggestions to overcome this issue, such as working with the group to overcome hardware insufficiencies or giving homework and using the applications in groups with a few students.

> "*Technologically, the classroom should be equipped to use these in the classroom. Well, there may be a problem. What can be done to deal with this? We can give homework.*" (T4).

> "*First, it is necessary to explain how to use the application to the children, so they need to learn how to do it. So, extra time is needed, which means taking time from the lesson, and this should be planned well, which may be a problem*" (T5).

The weaknesses of the applications were also indicated in the open-ended forms regarding these situations. The negative aspects of the use of each application, and the views of each participant, are given in Figure 8. In Figure 8, the participants' views included problems that might be experienced regarding the use of each application. The findings support the data obtained from the interviews.
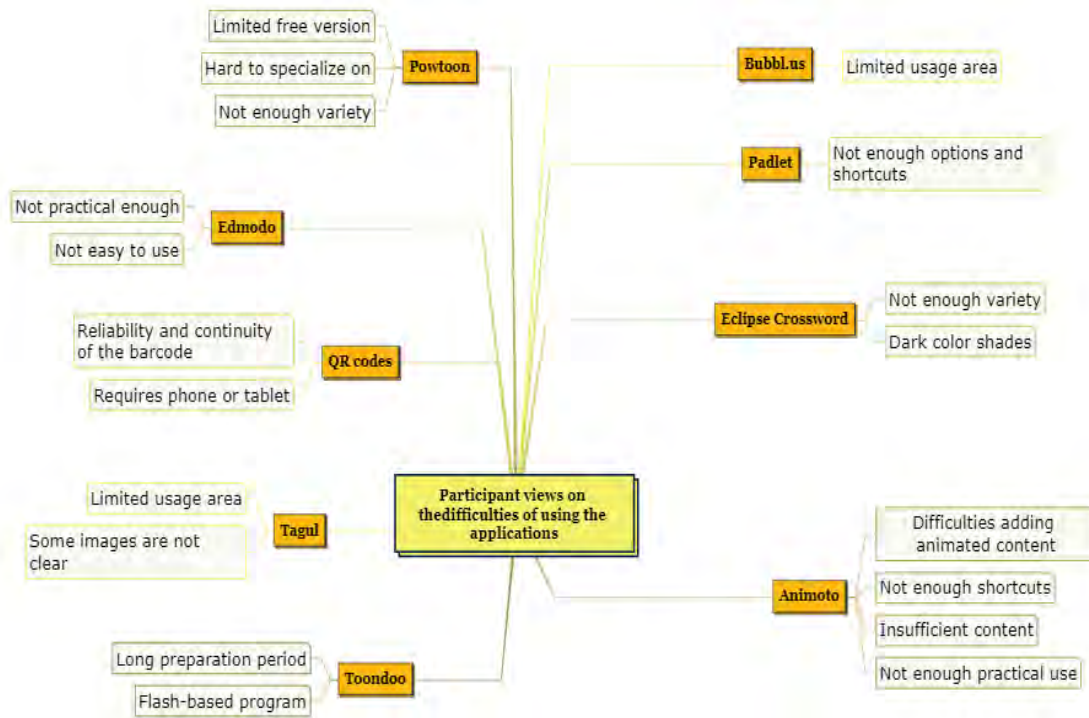
Fig 8. Participants' views on the negative aspects of using the applications

5. Discussion

The present study evaluated science teachers of gifted students who participated in a technology-based professional development program using the content analysis method of their opinions via interviews and open-ended forms. This section discusses the study's limitations, interpretations of the main findings, and suggestions. Teachers' ability to use technology effectively and efficiently depends on having technology-based professional development experiences (Mouza, 2002). The limitations of this study were considered as the participants were ten teachers. Since the students are gifted in SACs are consist of small groups, the data were gathered from two different SACs. In addition, not to disrupt teachers' lesson processes and plans, the duration of the professional development program was limited.

The analysis indicated that participants thought the applications in the technology-based program offered many benefits such as preparing for the lesson, supporting the class, differentiating instruction, increasing motivation, enriching the lesson, evaluating, and communicating. These outcomes are similar to many studies in the literature (Guilbault & McCormick, 2021; Kontostavlou & Drigas, 2019; Reis et al., 2021; Sayı & Soysal, 2022). Moreover, they detailed information about the use of the applications in the project-based learning process and explained the benefits of the tools provided in specific for each separately. Little & Housand (2011) showed that using online tools effectively communicate with colleagues in different locations provides professional learning experiences and supporting professional development. Although technology is not the only teaching tool in the education of gifted students, it is a way for teachers to create sustainable digital ecosystems and support their students' future success as a part of the teaching process (Besnoy et al., 2012). Another finding was that increasing the interest and motivation of the students while conducting the lesson supported existing literature (Heald, 2016; Zimlich, 2016); technology can be used for purposes such as enrichment, preparing the class, and evaluation.

In line with the results, it was determined that the program's contribution to teachers' professional development allowed them to get closer to the students' technology usage level and improve scholarly communication since they were not familiar with the most innovative technology applications. Besides,

the studies on technology generally address attributes such as attitude and sensory aspects (Kahveci, 2010; Yun et al., 2011). The limited number of practical studies in this area, especially implementation, is considered a significant deficiency (Periathiruvadi & Rinn, 2012; Bochkareva et al., 2018). Factors such as generation differences having little experience, and age were critical aspects of this situation, and the training helped eliminate these effects (Hawkins, 2020). In addition, there were some weaknesses in using digital technologies on the part of teachers that little guidance is provided on technology in the teachers' education process (Gruszczynska et al., 2013). Hence, they tend to choose the technologies they operate from a limited range of options (DeCoito & Richardson, 2018; McGuire, 2012). Other obstacles that were declared stemmed from the applications themselves, such as the limited amount of content in the free versions of the applications compared with the more extensive range of the paid version. In addition, the participants mentioned that there might be problems in accessing some websites in schools due to security reasons. An et al. (2009) reported that students with outdated computers often experienced technical issues using Web 2.0 tools. One of the biggest obstacles to using Web 2.0 applications is a lack of time, knowledge, skill, and budget constraints (Pritchett et al., 2013). Other challenges of using Web 2.0 tools can be listed as inadequate knowledge of technology and technical issues such as poor internet connectivity (Hassan et al., 2021), creating the materials, time-consuming use, lack of technology and access (Arslan & Coştu, 2021), being no proper guidance how to use Web 2.0 applications (Dollah & Mahmud, 2022).

This research further suggests that the program was perceived as a way of scholarly communication and mentoring. The participants stated that their experience allowed them to create a communication link between teachers and academics that was important in establishing communication links regarding the needs and demands of education. Similarly, Martin et al. (2010) state that effective educational technologies depend on professional development programs and ongoing support. Zimlich (2012) declares that exposure to more experienced people in terms of technology will increase the success of other teachers when it comes to using technology, thanks to local support structures such as mentorship. It has been shown that ensuring the time, proximity, responsiveness, and availability of support structures makes a difference for teachers.

6. Conclusions and Suggestions

Technology-based professional development programs need to provide teachers with various activities such as discussion, brainstorming, hands-on activities, and just-in-time support (Mouza, 2002). Although there are many examples of the teachers' use of applications in many areas, some problems may be experienced. One of these problems is the lack or insufficiency of the hardware required to integrate the applications into the classroom and the lack of technical support (Wachira & Keengwe, 2011).

The findings showed that the technology-based program professional development program contributed to teachers of gifted students in terms of technology use as enrichment activities. The participants became aware of using Web 2.0 tools for the aspect of a wide range; such as integrating into project making process, differentiating the lesson, motivating the students (Heald, 2016; Zimlich, 2016), and communicating (Baran & Ata, 2013), collaboration (Zimlich, 2016) and making presentations. Thus, there should be more research on Web 2.0 tools and their effectiveness in determining teachers' technology integration process needs and deficiencies (Periathiruvadi & Rinn, 2012). Another conclusion of the study was that there might be a waste of time when using the applications due to not being familiar. This finding reveals the importance of preparing from pre-service levels for the successful use of Web 2.0 tools in their future classes (Banas & York, 2014; Sadaf et al., 2012).

Based on the findings, the technology-based program on the ASSURE model was beneficial in contributing to teachers' professional development, increasing use of digital technology tools, raising their awareness of the opportunities afforded, and using the tools in lessons. These findings are not only limited to the education of teachers of gifted students. It would also be helpful in other teacher education areas. Since the participants positively evaluated this experience to contribute to their professional

development, it will be possible to use the model in different fields of study to implement technology integration applications. Eventually, it is wished to highlight some implications for practitioners and other researchers for the professional development of teacher education. As determining the readiness and learning needs of the students is essential in terms of individual differences, ASSURE model-based technology integration practices in the lesson plan preparation and teaching processes in the teacher education process could be conducted.

References

Ali, H., & Alrayes, A. (2019). The role of technology in gifted and talented education: A review of descriptive and empirical research. *KnE Social Sciences*, 26-38. https://knepublishing.com/index.php/Kne-Social/article/view/5165

An, Y. J., Aworuwa, B., Ballard, G, & Williams, K. (2009*). Teaching with Web 2.0 technologies: Benefits, barriers and best practices*. Annual Proceedings-Louisville Vol1. Selected Research and Development Papers read at the Annual Convention of the Association of Educational Communications and Technology Sponsored by the Research and Theory Division, Louisville, KY.

Banas, J. R., & York, C. S. (2014). Authentic learning exercises as a means to influence pre-service teachers' technology integration self-efficacy and intentions to integrate technology. *Australasian Journal of Educational Technology*, 30(6), 728-746. https://doi.org/10.14742/ajet.362

Barak, M. (2017). Science teacher education in the twenty-first century: A pedagogical framework for technology-integrated social constructivism. *Research in Science Education*, 47(2), 283-303. https://doi.org/10.1007/s11165-015-9501-y.

Baran, B., & Ata, F. (2013). Üniversite öğrencilerinin Web 2.0 teknolojileri kullanma durumları, beceri düzeyleri ve eğitsel olarak faydalanma durumları.[University students' Web 2.0 technologies usage, skill levels and educational usage] *Eğitim ve Bilim*, 38(169), 193-208. http://egitimvebilim.ted.org.tr/index.php/EB/article/viewFile/1937/507

Batanero, J. M. F., Rebollo, M. M. R., & Rueda, M. M. (2019). Impact of ICT on students with high abilities. Bibliographic review (2008–2018). *Computers & Education*, 137, 48-58. https://doi.org/10.1016/j.compedu.2019.04.007.

Besnoy, K. D., Dantzler, J. A., & Siders, J. A. (2012). Creating a digital ecosystem for the gifted education classroom. *Journal of Advanced Academics*, 23(4), 305-325. https://doi.org/10.1177/1932202X12461005.

Bochkareva, T., Akhmetshin, E., Osadchy, E., Romanov, P., & Konovalova, E. (2018). Preparation of the future teacher for work with gifted children. *Journal of Social Studies Education Research, 9*(2), 251-265. https://dergipark.org.tr/en/download/article-file/496770

Creswell, J. W. (2018). *Nitel araştırma yöntemleri: Beş yaklaşıma göre nitel araştırma ve araştırma deseni*.[Qualitative Inquiry and Research Design Choosing Among Five Approaches].Ankara: Siyasal.

Dag, F. (2016). Examination of the professional development studies for the development of technological competence of teachers in Turkey in the context of lifelong learning. *Journal of Human Sciences*, 13(1), 90-111. https://doi:10.14687/ijhs.v13i1.3523.

DeCoito, I., & Richardson, T. (2018). Teachers and technology: Present practice and future directions. *Contemporary Issues in Technology and Teacher Education*, 18(2), 362-378.(EJ1181412)ERIC. https://eric.ed.gov/?id=EJ1181412.

Denzin, N. K. (1989). *The research act*. Englewod Cliffs. *N. J: Prentice Hall*.

Dolenc, K., & Aberšek, B. (2015). TECH8 intelligent and adaptive e-learning system: Integration into technology and science classrooms in lower secondary schools. *Computers & Education*, 82, 354-365. https://doi.org/10.1016/j.compedu.2014.12.010.

Dollah, M. H., & Mahmud, S. N. D. (2022). The relevance of demographic factors to the use of Web 2.0 applications among science teachers. *International Journal of Academic Research in Business and Social Sciences, 12*(3), 559–571. http://dx.doi.org/10.6007/IJARBSS/v12-i3/12159

Duman, B. (2015). *21. yüzyılda öğrenmeyi keşfetmek*. A. Arı (Ed.), Öğretim Teknolojileri ve Öğrenme Araçları (ss:29-53). [Exploring learning in the 21st century]**.** Eğitim, Konya.

Giavrimis, P., Papanis, E. ve Papanis, E. M. (2011). Information and communication technologies and development of learners' critical thinking: Primary school teachers' attitudes. *International Education Studies*, *4*(3), 150-160. https://doi.org/10.5539/ies.v4n3p150.

Gruszczynska, A., Merchant, G., & Pountney, R. (2013). Digital futures in teacher education: Exploring open approaches towards digital literacy. *Electronic Journal of E-Learning*, *11*(3), 193-206. (EJ1016248).ERIC. https://eric.ed.gov/?id=EJ1016248.

Guilbault, K. M., & McCormick, K. (2021). Supporting elementary gifted learners during the COVID-19 pandemic: A survey of teaching practices. *Gifted Education International*, https://doi.org/10.1177/02614294211070075.

Hassan, I., BaraU Gamji, M., Yahaya Nasidi, Q., & Latiff Azmi, M. N. (2021). Challenges and benefits of web 2.0-based learning among international students of English during the Covid-19 pandemic in Cyprus. *Arab World English Journal. Arab World English Journal (AWEJ)* Special Issue on Covid 19 Challenges April 2021. https://dx.doi.org/10.24093/awej/covid.22

Hawkins Jr, R. B. (2020). *Teachers' perceptions and experiences in implementing mobile technology into elementary grades K to 4*. (Publication No. 27666796) [Doctoral dissertation, Grand Canyon University]. ProQuest Dissertations Publishing.

Heald, S. B. (2016). *Curriculum differentiation for gifted learners using instructional technology: A multiple-case study*. (Publication No. 10105310) [Doctoral dissertation, Northcentral University]. ProQuest Dissertations Publishing.

Heinich, R., Molenda, M., Russell, J.D., & Smaldino, S. (2002). *Instructional media and technologies for learning (7th ed.*). Columbus, OH: Merrill/Prentice Hall.

Kahveci, M. (2010). Students' perceptions to use technology for learning: Measurement integrity of the modified Fennema-Sherman attitudes scales. *Turkish Online Journal of Educational Technology-TOJET*, *9*(1), 185-201. (EJ875782). ERIC. https://eric.ed.gov/?id=EJ875782.

Kim, D., & Downey, S. (2016). Examining the use of the ASSURE model by K–12 teachers. *Computers in the Schools*, *33*(3), 153-168. https://doi.org/10.1080/07380569.2016.1203208

Koh, J. H. L., Chai, C. S., & Lim, W. Y. (2017). Teacher professional development for TPACK-21CL: Effects on teacher ICT integration and student outcomes. *Journal of Educational Computing Research*, *55*(2), 172-196. https://doi.org/10.1177/0735633116656848

Kontostavlou, E. Z., & Drigas, A. S. (2019). The Use of Information and Communications Technology (ICT) in Gifted Students. *International Journal of. Recent Contributions Engineering, Science & IT*, *7*(2), 60-67. https://doi.org/10.3991/ijes.v7i2.10815

Lee, J., & Jin, S. (2015).Teachers recognition on enhancing ICT related capabilities of gifted students. *Journal of Gifted/Talented Education*, *25*(2), 261–277. https://doi.org/10.9722/JGTE.2015.25.2.261.

Little, C. A., & Housand, B. C. (2011). Avenues to professional learning online: Technology tips and tools for professional development in gifted education. *Gifted Child Today*, *34*(4), 18-27. https://doi.org/10.1177/1076217511415383.

Martin, W., Strother, S., Beglau, M., Bates, L., Reitzes, T., & McMillan Culp, K. (2010). Connecting instructional technology professional development to teacher and student outcomes. *Journal of Research on Technology in Education*, *43*(1), 53-74. https://doi.org/10.1080/15391523.2010.10782561

Matzen, N. J., & Edmunds, J. A. (2007). Technology as a catalyst for change: The role of professional development. *Journal of Research on Technology in Education*, *39*(4), 417-430. https://doi.org/10.1080/15391523.2007.10782490

McGuire, M. S. (2012). *Technology as a tool: Uses in differentiated curriculum and instruction for gifted learners.* (Publication No. 3551714) [Doctoral dissertation, University Of Southern Calıfornia]. ProQuest Dissertations Publishing.

Mofield, E. L. (2020). Benefits and barriers to collaboration and co-teaching: Examining perspectives of gifted education teachers and general education teachers. *Gifted Child Today*, *43*(1), 20-33. https://doi.org/10.1177/1076217519880588

Mouza, C. (2002). Learning to teach with new technology: Implications for professional development. *Journal of Research on Computing in Education*, *35*(2), 272-289. https://doi.org/10.1080/15391523.2002.10782386

Murthy, S., Iyer, S., & Warriem, J. (2015). ET4ET: A large-scale faculty professional development program on effective integration of educational technology. *Journal of Educational Technology & Society*, *18*(3), 16-28. https://www.jstor.org/stable/jeductechsoci.18.3.16

Patton, M. Q. (2014). *Nitel araştırma ve değerlendirme yöntemleri*. [Qualitative research & evaluation methods integrating theory and practice] Ankara: Pegem.

Periathiruvadi, S., & Rinn, A. N. (2012). Technology in gifted education: A review of best practices and empirical research. *Journal of Research on Technology in Education*, *45*(2), 153-169. https://doi.org/10.1080/15391523.2012.10782601

Potts, J. A., & Potts, S. (2017). Is your gifted child ready for online learning?. *Gifted Child Today*, *40*(4), 226-231. https://doi.org/10.1177/1076217517722182

Pritchett, C. G., Pritchett, C. C., & Wohleb, E. C. (2013). Usage, barriers, and training of Web 2.0 technology applications. *SRATE Journal*, *22*(2), 29-38. (EJ1015771).ERIC. https://eric.ed.gov/?id=EJ1015771.

Reid, E., & Horváthová, B. (2016). Teacher training programs for gifted education with focus on sustainability. *Journal of Teacher Education for Sustainability*, *18*(2), 66-74. https://doi.org/10.1515/jtes-2016-0015.

Reis, S. M., Renzulli, S. J., & Renzulli, J. S. (2021). Enrichment and gifted education pedagogy to develop talents, gifts, and creative productivity. *Education Sciences*, *11*(10), 615. https://doi.org/10.3390/educsci11100615

Robinson, A., Shore, B. M., & Enersen, D. L. (2014). Üstün zekalılar eğitiminde en iyi uygulamalar/Kanıt temelli bir kılavuz. [*Best practices in gifted education: An evidence-based guide*]. Ankara: Nobel.

Sadaf, A., Newby, T. J., & Ertmer, P. A. (2012). Exploring pre-service teachers' beliefs about using Web 2.0 technologies in K-12 classroom. *Computers & Education*, *59*(3), 937-945. https://doi.org/10.1016/j.compedu.2012.04.001

Sayı, A. K. & Soysal, Ö. M. (2022). Digital differentiation in gifted education. In *Creating Equitable Services for the Gifted: Protocols for Identification, Implementation, and Evaluation* (pp. 205-225). IGI Global.

Seredina, A. Y., Pomortseva, N. P., & Morozova, T. V. (2016). Best practices of the United States'gifted education teacher-training programs. *International Journal of Humanities and Cultural Studies, 1*(1), 145-150. https://kpfu.ru/staff_files/F1044744280/2095_6142_1_PB.pdf

Shaunessy, E. (2007). Implications for gifted education. *Gifted Child Quarterly*, *51*(2), 119-135. https://doi.org/10.1177/0016986207299470.

Shelly, G. B., Gunter, G. A., & Gunter, R. E. (2012). *Teachers discovering computers: Integrating technology in a connected world.* Cengage Learning.

Smaldino, S. E., Russell, J. D., Heinich, R., & Molenda, M. (2005). The ASSURE model: Creating the learning experience. *Instructional Technology and Media for Learning*, 4-5.

Smaldino, S. E., Lowther, D. L., Russell, J. D., & Mims, C. (2008). *Instructional technology and media for learning.* Pearson, 330 Hudson Street.

Spiteri, M., & Chang Rundgren, S. N. (2020). Literature review on the factors affecting primary teachers' use of digital technology. *Technology, Knowledge and Learning*, *25*(1), 115-128. https://doi.org/10.1007/s10758-018-9376-x

Stake, R.E. (1995). *The art of case study research*. Thousand Oaks, CA: Publisher.

Tatli, Z., & Akbulut, H. I. (2017). Öğretmen adaylarının alanda teknoloji kullanımına yönelik yeterlilikleri. *Ege Eğitim Dergisi*, *18*(1), 31-55. https://doi.org/10.12984/egeefd.328375.

Thurm, D., & Barzel, B. (2020). Effects of a professional development program for teaching mathematics with technology on teachers' beliefs, self-efficacy and practices. *ZDM*, *52*(7), 1411-1422. https://doi.org/10.1007/s11858-020-01158-6

Voogt, J., & McKenney, S. (2017). TPACK in teacher education: Are we preparing teachers to use technology for early literacy? *Technology, Pedagogy and Education*, *26*(1), 69-83. https://doi.org/10.1080/1475939X.2016.1174730

Wachira, P., & Keengwe, J. (2011). Technology integration barriers: Urban school mathematics teachers perspectives. *Journal of Science Education and Technology*, *20*(1), 17-25. https://doi.org/0.1007/s10956-010-9230-y.

Yin, R. K. (1981). The case study crisis: Some answers. *Administrative Science Quarterly*, *26*(1), 58-65. https://doi.org/10.2307/2392599.

Yun, K., Chung, D., Jang, B., Kim, J. H., & Jeong, J. (2011). Mathematically gifted adolescents have deficiencies in social valuation and mentalization. *PloS one*, *6*(4), 1-6. https://doi.org/10.1371/journal.pone.0018224.

Zimlich, S. L. (2012). *Using technology in gifted and talented education classrooms: The teachers' perspective.* [Unpublished Doctoral dissertation]. https://ir.ua.edu/bitstream/handle/123456789/1397/file_1.pdf?sequence=1&isAllowed=y.

Zimlich, S. L. (2016). Motivating gifted students: Technology as a tool for authenticity and autonomy. *International Journal of Learning, Teaching and Educational Research, 15*(13), 1-11. https://www.ijlter.org/index.php/ijlter/article/view/833/pdf

Zimlich, S. (2017). Technology to the rescue: Appropriate curriculum for gifted students. *International Journal of Learning, Teaching and Educational Research*, *16*(9), 1-12. https://doi.org/10.26803/ijlter.16.9.1