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Research Article

Integrating AI Applications into Learning Management Systems to Enhance e-Learning

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ABSTRACT

Artificial intelligence technologies have the potential to greatly enhance the organization of learning management systems and online learning experiences. In particular, the public release of OpenAI's GPT-3 model in December 2022 has given society a chance to learn more about the current status of artificial intelligence. There have been much research on the use of artificial intelligence in e-learning processes, but very few of them demonstrate how to integrate these applications step-by-step and with examples into learning management systems. This study intends to close this gap by demonstrating how artificial intelligence technologies are integrated into learning management systems using real-world examples. This study provides examples of practical applications as well as integration steps. Finally, GPT-3 plugins for Moodle are examined and sample JavaScript code is included for integrating Chat GPT into Moodle. By presenting a useful guide for integrating artificial intelligence technology into learning management systems, this work adds to the body of literature.

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E-Öğrenmeyi Desteklemek için Yapay Zeka Uygulamalarının Öğrenme Yönetim Sistemlerine Entegrasyonu

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ÖZET

Yapay zekâ teknolojileri, öğrenme yönetim sistemlerinde çevrimiçi öğrenme deneyimlerini ve yönetimini önemli ölçüde geliştirme potansiyeline sahiptir. Özellikle Aralık 2022'de OpenAI'ın GPT-3 modeli çıktılarını herkese açık hale getirmesi yapay zekanın ulaştığı noktayı daha iyi anlamak için toplumsal bir fırsat yaratmıştır. Yapay zekanın e-öğrenme süreçlerinde kullanımı üzerine birçok çalışma olsa da bunların çok azında yapay zekâ uygulamalarının öğrenme yönetim sistemlerine entegrasyonu adım adım ve örneklerle sunulmaktadır. Bu çalışma, yapay zekâ teknolojilerinin öğrenme yönetim sistemlerine entegrasyon sürecini pratik örneklerle sunarak bu boşluğu doldurmayı amaçlamaktadır. Çalışmada; entegrasyon adımları ve kullanılabilecek örnek uygulamalara yer verilmiştir. Son olarak, GPT-3 modellerine ilişkin eklentilere yer evrilmiş ve Chat GPT'nin Moodle entegrasyonu için örnek JavaScript kodları sunulmuştur. Bu çalışma, yapay zekâ teknolojilerinin öğrenme yönetim sistemlerine entegrasyonu için pratik bir rehber sunarak literatüre katkıda bulunmaktadır.

1. Introduction

Learning Management Systems (LMS) are platforms used to deliver and manage online learning content and experiences. LMSs are used by educational institutions, businesses, and other organizations to provide online learning opportunities to students and employees. The most widely used open-source LMSs worldwide are Canvas and Moodle. The examples given in this research are limited to Canvas and Moodle.

Increasing demands and expectations for online learning in the digital world have created a pressure for clear development on LMSs. In particular, the promise of big data-focused personalized learning through learning analytics, the emergence of Learning Experience Platforms (LXP), the rapid development of artificial intelligence technologies and its clear demonstration in real-life applications indicate that a strong integration period can be entered into in LMSs.

An LMS is a software platform used to deliver and manage online learning content and experiences. In recent years, Learning Experience Platforms (LXP) have emerged as an alternative to LMS. LXP platforms are designed to offer personalized learning experiences to students. LXPs typically include features such as content recommendation algorithms, adaptive learning capabilities, and social learning tools and can be used in conjunction with an LMS.

While both platform types offer similar features, they differ in their approach to learning and target audience. LMSs are designed to support the delivery of structured courses and programs, while LXPs focus on providing personalized learning experiences to students. LMSs typically include features such as course management, communication tools, and assessment tools, while LXPs include features such as content recommendation algorithms, adaptive learning capabilities, and social learning tools (Clark and Mayer, 2016; Valdiviezo and Crawford, 2020). Another difference between LMS and LXP is their target audience. While LMSs are generally used by educational institutions, businesses, and other organizations to provide online learning to students and employees, LXPs are generally designed for individual learners and can be used in conjunction with an LMS (Weigert and Behrendt, 2022). When comparing the effectiveness of LMS and LXP, certain features of LXP or LMS may stand out. However, it can be said as a common opinion that LMSs are much more widely accepted and used. Given that LXPs can also be used within LMSs, it can be said that more focus should be given to LMSs. Additionally, learner records in LMSs can also be processed with algorithms such as KNN, Naive Bayes, SVM, CART, and C5.0, similar to LXPs, and thus support learning processes (Yavuzarslan and Çiğdem, 2022).

1.1. Using Artificial Intelligence in e-Learning

The use of artificial intelligence (AI) in e-learning has gained great interest in recent years due to its potential to enhance the effectiveness and accessibility of education. Especially with the Chat GPT application released to the public by OpenAI in December 2022, which reached 1 million users in 5 days, many people had the opportunity to directly experience the level of AI achieved (Firat, 2023). In the literature, many researchers have investigated the integration of AI for various purposes in e-learning, including personalized learning, assessment and grading, educational games, and simulations (Kothari and Verma, 2022).

Personalized learning, also known as adaptive or individualized learning, refers to the use of technology to adapt educational content and experiences to the unique needs, interests, and abilities of each student (Fariani, Junus, and Santoso, 2022). It has been found to increase student motivation and engagement and improve learning outcomes (Manciaracina, 2022). AI-supported personalized learning systems can analyze data on a student's performance, preferences, and other factors to create customized learning paths and provide targeted support and feedback (Tapalova and Zhiyenbayeva, 2022).

AI can also be used for assessment and grading in e-learning. AI-supported assessment tools such as multiple-choice test graders and composition scoring software can automatically grade student submissions, allowing teachers to save time and effort and focus on providing personalized feedback and support (Bearman, Nieminen, and Ajjawi, 2022). AI-supported grading can also provide more objective and consistent grading, reducing the potential for bias and error.

Educational games and simulations are another area where AI can play a valuable role in e-learning. AI-supported games and simulations can provide engaging and interactive learning experiences that can help students develop critical skills such as problem-solving, decision-making, and creativity (Bennani, Maalel, and Ben Ghezala, 2022). For example, AI-supported virtual simulations can allow students to experiment with complex scenarios and test their knowledge and skills in a safe and controlled environment.

AI has the potential to improve the effectiveness and accessibility of e-learning in various ways. Personalized learning, assessment and grading, and educational games and simulations are some of the key use cases where AI can provide significant benefits to students and educators. However, it is important to carefully evaluate the ethical and pedagogical implications of using AI in education and ensure that the technology is used to enhance, rather than replace, human teaching and learning.

1.2. Research Purpose

There are numerous studies in the relevant literature regarding how AI can be used in e-learning processes. Additionally, there are studies that provide framework structures for the integration of AI in LMSs (Pardamean et al., 2021). However, studies that present the integration process of AI technologies into LXP or LMSs with simple steps and application examples are quite limited (Eggmann, 2022). It is believed that this study will contribute to filling this gap in the literature. In this context, the aim of the study is to present the integration process of artificial intelligence technologies into LMSs with application examples. Accordingly, steps for AI integration in LMSs, areas of AI use in LMSs, and code examples that can be utilized are provided along with examples.

2. AI Integratıon in LMS

It is possible to mention the basic steps to integrate artificial intelligence applications into any LMS. There are numerous artificial intelligence application platforms in the market for different usage areas. This number has been rapidly increasing in recent years. In this section, first, the integration steps are discussed, then artificial intelligence examples are provided according to different usage areas. Finally, the process is demonstrated through a real example. For this, the steps for integrating Chat GPT into Moodle and the JavaScript codes that can be used are provided.

2.1. Integration Steps

The steps to be followed to integrate AI applications into an LMS may vary depending on the LMS structure. However, to provide a general understanding, five steps that can be followed for AI integration with all LMSs can be mentioned.

1) *Determining the AI application:* The first step in integrating AI into an LMS is to determine the AI application to be installed. The selected AI application can be related to personalized learning, assessment and grading, or educational games and simulations. It is important to understand a specific AI application and how it aligns with educational goals and objectives clearly to avoid unnecessary time and cost.

2) *Selecting the AI platform:* After determining the AI application, the next step is to select a AI platform that can support it. Various AI platforms are available, each with different features. Examples of artificial intelligence platforms for e-learning include *Google Cloud AI*, *Microsoft Azure Machine Learning*, and *IBM*

Watson. It is necessary to carefully evaluate the features and capabilities of different AI platforms to ensure that the selected platform meets the needs.

3) *Integrating the AI platform with the LMS:* After selecting a AI platform, the next step is to integrate it with the LMS. This usually involves adding the API (application programming interface) of the AI platform to the LMS, which enables the two systems to communicate and exchange data. The characteristics of this integration process will depend on the AI platform used and the LMS.

4) *Installing and configuring the AI application:* After the AI platform is integrated into the LMS, the next step is to install and configure the AI application. This includes creating and uploading necessary data or content as well as configuring settings or parameters. For example, if a AI-supported personalized learning system is being implemented, student data needs to be uploaded (introduced) to the system and customized learning paths need to be determined.

5) *Testing and evaluating the AI application:* After the AI application is installed and configured, it needs to be tested and evaluated to ensure that it works correctly and achieves the desired results. This involves conducting pilot implementation with a user group and collecting feedback. Thus, data collected about the effectiveness of the AI application is analyzed, and the results are used to improve AI integration.

2.2. Usage Areas and Sample Applications

The AI applications can be used for many purposes in LMSs. It is possible to categorize the prominent usage areas under three headings: personalized learning, assessment and evaluation, educational games and simulations.

1) *Personalized learning:* Personalized learning, which involves using technology to adapt educational content and experiences to each student's unique needs, interests, and abilities, is one of the most common applications of artificial intelligence in LMSs. IBM Watson platform is one of the AI platforms used for personalized learning in LMSs. The IBM Watson artificial intelligence platform can be used to analyze student data and create customized learning paths. To do this, the platform's API is first integrated into the LMS, and then student data is uploaded to the system to create personalized learning paths. Examples of artificial intelligence applications that can be integrated for personalized learning in LMSs such as Canvas and Moodle are *IBM Watson*, *Google Cloud AI*, *GPT-3 models* and *Knewton Adaptive Learning*. AI can also be used to create adaptive learning systems that adjust learning content and experiences in LMSs

based on student performance and progress. *Smart Sparrow* and *Learnosity* are examples of AI applications for adaptive learning in LMSs such as Canvas and Moodle.

2) *Assessment and evaluation:* Artificial intelligence can also be used to score open-ended text entries (such as compositions) or multiple-choice tests. Examples of AI technologies that can be used for this purpose are ChatGPT, Gradescope, and e-rater. For example, when the API provided by *Microsoft Azure Machine Learning* is integrated into an LMS, students' compositions, assignments, or any text they enter can be scored by artificial intelligence. When the LMS is integrated with the AI platform's API, student composition submissions will be automatically graded by the AI tool.

3) *Educational games and simulations:* Artificial intelligence-supported educational games and simulations can provide engaging and interactive learning experiences that can help students develop critical skills such as problem solving, decision making, and creativity. An example of integrating artificial intelligence into an LMS for educational games and simulations is possible. A platform that supports artificial intelligence such as those provided by *Google Cloud AI* or *IBM Watson* can be used. Additionally, *Classcraft, Quest Atlantis*, and *Kahoot!* can also be integrated into LMSs for AI-supported games and simulations. When the LMS is integrated with the AI platform's API, students can access games or simulations through the LMS. Thus, an integrated learning environment is provided on the same platform.

In general, there are various AI applications, APIs, and plugins that can be integrated into many LMSs such as Canvas and Moodle to increase the effectiveness and accessibility of e-learning. At this point, it becomes even more important to carefully evaluate the specific needs and goals of students and organizations and choose AI solutions that are suitable for these needs. The integration of the Chat GPT artificial intelligence platform, which gained widespread use worldwide in December 2022, into Moodle is given as an example integration in the next section.

2.3. Chat GPT Integration to Moodle

To integrate Chat GPT (GPT-3) into Moodle, it should be remembered that the GPT-3 API should be used to generate text according to the request and parameters. Essentially, the steps that can be followed to integrate GPT-3 with Moodle are as follows:

1) *Access to the GPT-3 API:* sign up for an API key from the OpenAI website (https://beta.openai.com/signup/).

2) *Determining the Usage Purpose:* it should be determined how and for what purpose GPT-3 will be used in Moodle. GPT-3 can be used to create summaries of reading materials, create multiple choice questions, or create personalized feedback for students.

3) *Creating a Prompt:* after deciding on specific tasks for using GPT-3, a prompt should be created for the model. The prompt is a short text that specifies the task and provides the context or information required for the model to generate text. For example, if we want to use GPT-3 to create multiple choice questions, we need to specify the question stem, placeholders for the correct answer and wrong answers in the prompt.

4) *Using the GPT-3 API:* after creating the prompt, the GPT-3 API can be used to send the prompt to the model and receive the generated text in response. The API allows various parameters to be set, such as the length of the generated text and the confidence level required for the model to return a response.

5) *Using in LMS:* in the final stage, the generated text can be used appropriately in Moodle. For example, the created multiple choice questions can be used as part of a quiz or exam, or the created summaries can be used as part of a reading assignment.

To integrate GPT-3 into Moodle, it may be necessary to write code to send requests to the GPT-3 API and receive the generated text in response. A programming language such as Python or JavaScript can be used for this purpose. Sample JavaScript code that can be used to integrate Chat GPT into a Moodle page is given in Figure 1 below.

Figure 1

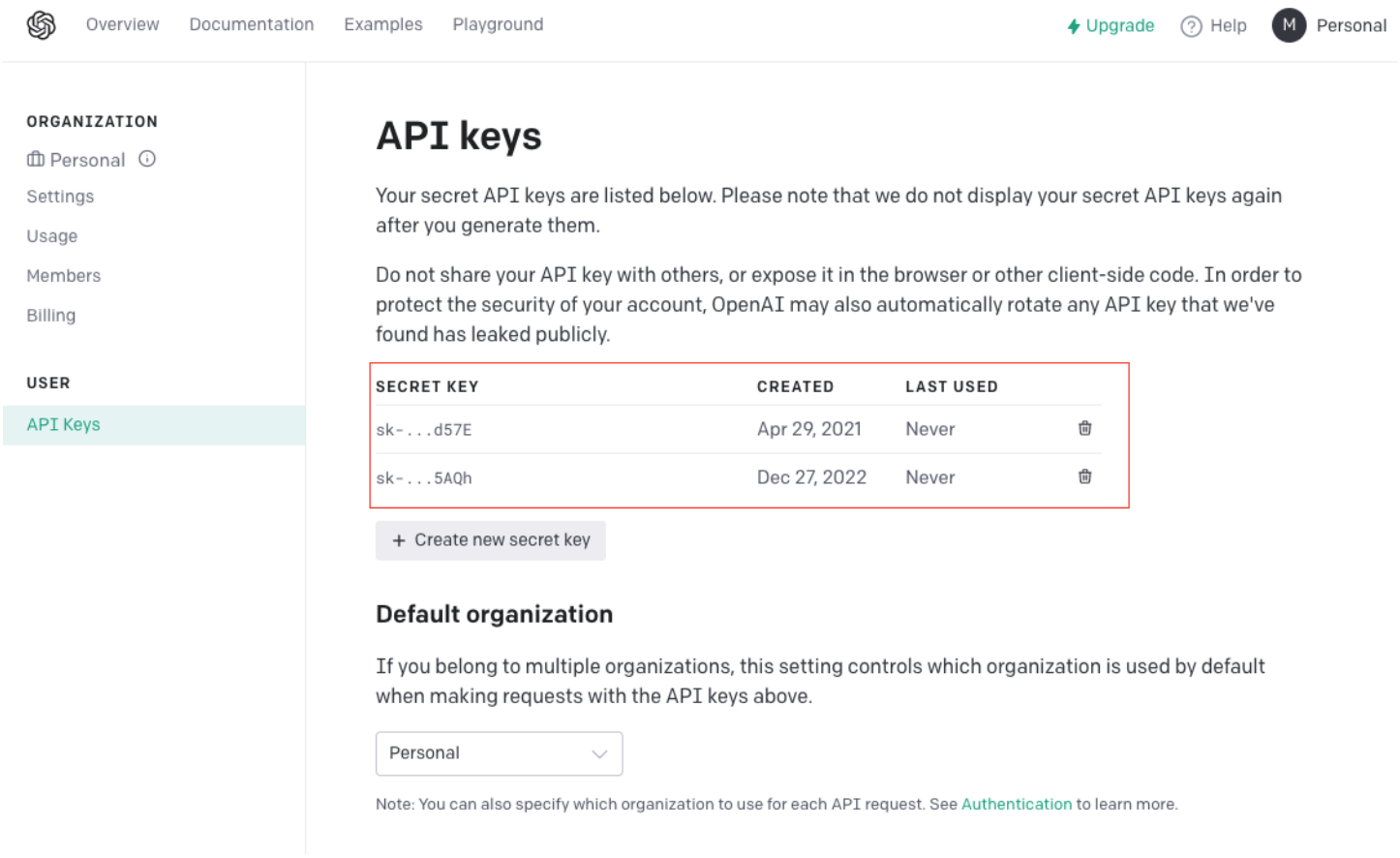
Sample JavaScript code to integrate ChatGPT into Moodle

```javascript
// Add the ChatGPT script to your Moodle page
var chatGPTScript = document.createElement('script');
chatGPTScript.src = 'https://cdn.jsdelivr.net/npm/@openai/chatgpt@0.2.0/dist/chatgpt.min.js';
document.head.appendChild(chatGPTScript);

// Wait for the script to load
chatGPTScript.addEventListener('load', function() {
  // Initialize the ChatGPT instance
  var chatGPT = new OpenAI.ChatGPT({
    apiKey: 'Your Api Key', // Replace with your OpenAI API key
    model: 'text-davinci-002', // Replace with the model you want to use
    temperature: 0.7, // Adjust the temperature to control the "creativity" of the AI's responses
    maxTokens: 50 // Set the maximum length of the AI's responses
  });

  // Find the Moodle chat element and add a listener for when the user submits a message
  var chatInput = document.querySelector('#id_message');
  var chatForm = chatInput.closest('form');
  chatForm.addEventListener('submit', function(e) {
    e.preventDefault();

    // Get the user's message from the chat input field
    var userInput = chatInput.value.trim();

    // Clear the chat input field
    chatInput.value = '';

    // Send the user's message to the ChatGPT instance to generate a response
    chatGPT.generateResponse(userInput)
      .then(function(response) {
        // Append the AI's response to the chat window
        var chatWindow = document.querySelector('.messageboxcontent');
        chatWindow.insertAdjacentHTML('beforeend', '<div class="message other">' + response.text + '</div>');
      })
      .catch(function(error) {
        console.error(error);
      });
  });
});
```

This code initializes a ChatGPT instance with the OpenAI API key (Figure 2) and the desired model, and then adds a listener to the Moodle chat input field. When the user sends a message, the code sends the message to the ChatGPT instance to generate a response, and then adds the AI's response to the chat window. This is just a basic example and the code can be modified as needed.

Figure 2

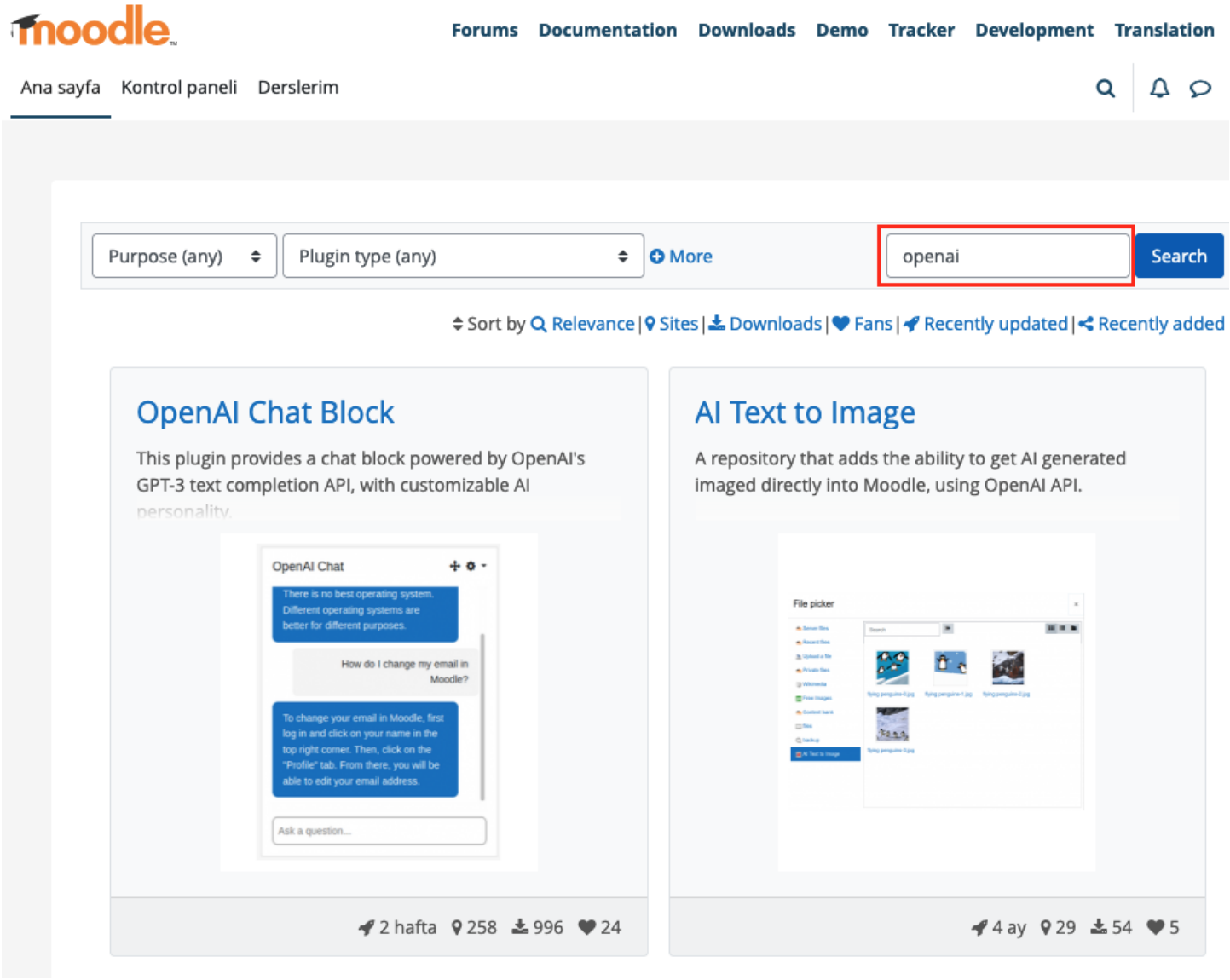
OpenAI GPT-3 API keys (https://platform.openai.com/account/api-keys)



When the existing Moodle plugins are examined, it is possible to see numerous plugins that focus on AI integration. Among them, a plugin has also been created for Chat GPT, whose integration process was explained above. With this plugin named *OpenAI Chat Block*, Chat GPT integration to Moodle can be made with ready interface preferences. This plugin provides a personalized chat block supported by OpenAI's GPT-3 text completion API. Additionally, the Moodle plugin named *AI Text to Image* is a plugin that supports visual production from text. Both plugins can be accessed from Moodle Plugins by searching for "openai" (Figure 3).

Figure 3

OpenAI plugins in moodle



The two OpenAI plugins that can be actively used in Moodle LMS are OpenAI Chat Block and AI Text to Image plugins. It is observed that OpenAI Chat Block has reached a higher number of downloads.

3. Conclusions and Suggestions

The aim of this study was to demonstrate the process of integrating AI technologies into LMSs through sample applications. Thus, process steps, sample applications, and codes were presented that could be useful not only for researchers but also for practitioners. However, it should not be forgotten that the integration of AI technologies into an LMS is a complex process that requires careful planning and evaluation. It has been observed

that users do not have sufficient knowledge about personal data privacy in AI usage (Başkaya and Karacan, 2022). In addition to the integration steps presented in the study, there are also several other factors that need to be considered when integrating AI into an LMS. These factors can be listed as follows:

1) *Security and privacy:* Ensuring the security and privacy of student data is crucial when integrating AI into an LMS. It is important to carefully evaluate data protection measures and ensure that all data is processed in accordance with relevant laws and regulations.

2) *Ethics:* The use of AI in education raises a number of ethical issues, including bias problems and the potential to replace human teaching and learning. It is important to carefully evaluate these issues and ensure that the use of AI is in compliance with ethical principles.

3) *Pedagogy/Andragogy:* The integration of AI into an LMS should be guided by pedagogical/andragogical considerations, such as how AI applications can support student learning and how they can be integrated into the overall teaching and learning process.

4) *Technical:* When integrating AI into an LMS, there are several technical considerations to take into account, including the compatibility of the AI platform with the LMS, the availability of necessary resources and infrastructure, and the need for continuous maintenance and support.

In general, the integration of AI into an LMS requires careful planning and evaluation in order to be effective and compatible with educational goals and objectives. By following the steps outlined above and carefully evaluating various relevant factors, it is possible to successfully integrate AI into an LMS and take advantage of its potential to increase the effectiveness and accessibility of education.

Ethical Statement and Conflict of Interest

There is no conflict of interest in the article. The study has not received funding from any institution or organization. Throughout this study, ethical standards and conditions of the Committee on Publication Ethics (COPE) have been followed, and scientific ethical principles and rules have been taken as a basis.

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Examination of the Effects of Digital Story Applications on Digital Parenting and Technology Usage Attitudes

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ABSTRACT

Children's active participation in the internet causes them to face online risks. In this direction, parents have the most prominent role in ensuring children participate in a safer and more conscious internet world and protect them from online risks. However, it is seen that most of the parents need help to keep up with the social transformation at a sufficient level. At this point, parents need to examine the concept of digital parenting. In this context, digital story activities were considered an effective tool. A digital story is defined as presenting narration based on sound, pictures, graphics, motion graphics, images, music, and text in an interactive digital environment. Based on all these situations, this study aims to reveal digital parenting competence and raise awareness by examining the effect of digital story activities on digital parenting on parents' digital parenting attitudes. At the same time, technology use attitudes of parents are revealed by examining their technology use. This research was designed with a mixed-method research model. The study group of the research consists of 40 parents with primary and secondary school students in the Science and Art Center with different socio-demographic characteristics in a province in the northwestern part of Turkey. A personal information form, a semi-structured interview form, and two different scales were used in the study. The most important result of this study is that design-based teaching activities such as digital story development contribute to the development of parents' awareness of digital parenting.

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Dijital Hikaye Geliştirme Etkinliklerinin Ebeveynlerin Dijital Ebeveynlik ve Teknoloji Kullanım Tutumlarına Etkisinin İncelenmesi

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ÖZET

Çocukların internet dünyasında aktif yer alması onları çevrim–içi risklerle karşı karşıya kalmasına neden olmaktadır. Bu doğrultuda çocukların daha güvenli ve bilinçli internet dünyasında yer alması ve çevrim-içi risklerden korunmalarında en büyük rol ebeveynlere düşmektedir. Fakat ebeveynlerin birçoğu toplumsal dönüşüme yeterli düzeyde ayak uyduramadığı görülmektedir. Bu nokta ebeveynlerin dijital ebeveynlik kavramını irdelemeleri oldukça önemlidir. Bu bağlamda dijital hikaye etkinliklerinin etkili bir araç olacağı düşünülmüştür. Dijital hikaye, etkileşimli dijital bir ortamda, ses, resim, grafik, hareketli grafik, görüntü, müzik ve metne dayalı anlatımın sunulma süreci olarak tanımlanmaktadır. Tüm bu durumlardan hareketle bu araştırmanın amacı, dijital ebeveynliği konu alan dijital hikâye etkinliklerinin, ebeveynlerin dijital ebeveynlik tutumlarına etkisini inceleyerek dijital ebeveynlik yeterliliğini ortaya koymak ve farkındalık kazandırmaktır. Aynı zamanda ebeveynlerin teknoloji kullanımları incelenerek teknoloji kullanım tutumları ortaya koymaktır. Bu araştırma karma yöntem araştırma modeliyle desenlenmiştir. Araştırmanın çalışma grubunu, Batı Karadenizin bir ilinde farklı sosyo-demografik özelliklere sahip Bilim ve Sanat Merkezinde ilkokul ve ortaokul öğrencisi çocuğu olan 40 ebeveyn oluşturmaktadır. Araştırmada kişisel bilgi formu, yarı yapılandırılmış görüşme formu ve 2 farklı ölçek kullanılmıştır. Bu araştırmanın en önemli sonucu dijital hikaye geliştirme gibi tasarım tabalı öğretim etkinliklerinin ebeveynlerin dijital ebeveynlik ile ilgili farkındalığının geliştirilmesine katkı sağlamasıdır.

1. Introduction

Individuals of all ages use even these technologies, it is observed that children are the ones who spend the longest time. Among the increasing yearly number of internet users, children as users have a significant place. Children use information technologies for many different objectives such as simple access to information, communicating, expressing emotions and opinions independently, amusement, game etc. (Durak & Kaygın, 2018). While using information technologies, children encounter some online risks (Gökçearslan et al., 2021). When the online risks children encounter is observed, they can be classified as content risks (wrong or harmful information), risks from related persons (cyberbullying or communicating with strangers), commercial risks (cyber fraud or pirate software) and hidden risks (sharing or stealing the personal information) (Livingstone & Haddon, 2009). At this point, parents have a big role in children's being in safe and in their being conscious internet users and in protection of them from online risks they may encounter. Yet, it is observed that most of the parents are not conscious enough about computer and internet use. At this point, parents must question digital parenting concept and share their experiences (Durak & Kaygin, 2020; Vezne, Atman-Uslu & Yildiz-Durak, 2022). In this study, it is aimed that parents develop their digital parenting awareness by using digital stories which subject digital parenting.

In line with the contributions of digital era, traditional storytelling produces digital stories by uniting multimedia technologies. Digital story can be described as the transfer of a scripted narration into digital environment by supporting it with various sounds and images. Digital storytelling is telling the story via digital technologies. A short film shooting the growing up of the food, a podcast about the medieval age, a blog novel about America in 1968, a repeating video about mother-daughter relation can be shown as examples for digital storytelling (Alexander, 2017). Digital story can be created via many applications (glogster, bitstrips, bitmoji, powtoon, animato, creaza, goanimate etc.) which can be accessed through the computer environment or through mobile devices (Yildiz Durak, 2018). The traditional storytelling has a characteristic of teaching-learning method for people. By turning the stories into digital stories now through the adaptation of technology to education, it is used as a content type in the teaching learning process throughout different disciplines (Lee, 2014; Yılmaz, Üstündağ, Güneş & Çalışkan, 2017). As well as they are used at such levels as preschool, elementary school, secondary school and higher education; digital stories are also used during teachers' education. However, when the literature is examined, it is observed that digital story activities are mostly performed with children,

youngsters, and teachers or prospect teachers. There is a need for further studies on the use of digital storytelling as a teaching activity in adult education.

1.1. Aim of the Research

The research aims to enable awareness by examining the effect of digital story activities about digital parenting on parents' digital parenting attitude. In the same time, by examining technology usage of the parents, their technology usage attitude will be manifested. In line with this aim, answers were searched for the below questions.

Sub-questions of the research are listed as follows:

- How are the parents' pretest and final test scores of digital parenting attitude and technology usage attitude?
- Is there a meaningful difference when the pretest scores are controlled between the study group to which digital story activities about digital parenting is applied and the control group's digital parenting attitude?
- Is there a meaningful difference when the pretest scores are controlled between the study group to which digital story activities about digital parenting is applied and the control group's media and technology usage and attitude?
- Do the parents' digital parenting attitude and their media and technology usage and attitudes differentiate based on gender, gender of the child, daily frequency of technology usage and age?
- What are the opinions of the study group about the application process during which digital stories are used?

2. Conceptual Framework

2.1. Digital Story

Development of the technology has made different and innovative educational approaches emerged. With the developing and disseminating technology, innovative educational approaches has started to emerge in learning-teaching environments. According to Robin (2006), story which is an effective method in learning and teaching was transferred to digital environments with the development of technology. Digital storytelling is an effective and strong learning strategy which has emerged through the use of simple technological instruments in the learning-teaching process (Robin & McNeil, 2012). The primitive men used cave walls to picture their stories. Today different technological instruments are needed and used for digital storytelling. Web 2.0 instruments, which is one of them, are technological environments which have a simple interface and in which users can easily

digitalize their stories. By putting together some media elements like picture, video and music; teachers, students or individuals can create digital stories through Web 2.0 instruments (Karoğlu, 2015).

The stories which can be written, read, stored and released in technological environments constitute the concept of "digital story". Digital storytelling in general is described as "the presentation process of the narration which is based on sound, picture, graphic, sprite graphic, image, music and script in an interactive digital environment" (Figa, 2004).

By enabling the learning environments to be attractive, digital storytelling makes the topic or the event intended to be narrated become more sufficiently understandable. As it happens for the traditional storytelling, when it comes to digital storytelling, the story also happens within the cycle of an event or a theme and it has an opinion. Digital story is a multimedia application which lasts nearly a few minutes and is created by composing the story intended to be told with a combination of images, sounds, and videos (Robin, 2006). Generally lasting 2 to 5 minutes, used to narrate a topic or situation; digital story is expressed as a narrative art (Doğan & Robin, 2008; Garrety, 2008; Kulla-Abbot, 2006; Maddin, 2011).

In educational environments, digital stories are used for such fields as literature, creative writing, social and cultural sciences, language learning, etc. As well as it is frequently used in educational environments, it is also being used for more than one informal field like psychology, history, public service announcements informative for the society, health, etc. (Karoğlu, 2015; Robin 2008). In the same time, there are many studies which mention the contributions of digital storytelling consisting a wide array of students from preschool to university. As an educational instrument, digital storytelling makes various contributions in learning-teaching process. As well as students themselves can create digital stories, they can also use digital story created by their teachers in order to understand a subject (Robin, 2006). Digital storytelling is not only created via Web 2.0 instruments but, they can also be created via such instruments as Scratch, MovieMaker, Microsoft Powerpoint, Microsoft Photostory (Karoğlu, 2015).

2.2. Digital Story Creation Process

In this part, the components a story should consist and the steps of digital story creation are explained.

Components of the Effective Digital Story

There are seven basic elements an effective digital story should have (Keleş, 2019). These elements are opinion, a stunning question, an emotional content, economy, an effective dubbing, power of the music and rhythm (Sarıtepeci,2016; Bull & Kajder, 2005).

Opinion: It is the step during which opinion of the person who created digital story and the message wanted to be conveyed through the story he/she structured with his/her experiences are set forth. The significant point in this step is that individuals constitute the very base of the story with their own opinions (Bull & Kajder, 2005).

A Stunning (Dramatic) Question: It is a question which attracts the attention, interest of the ones who watch the story and reply of which comes out at the end of the story. In this step, the narrator does not directly ask the question; the audience indirectly perceives the question at the beginning of the story or during the story (Robin, 2008).

An Emotional Content: It is the step during which the contents enabling the audience to get connected emotionally are placed in digital story. Pictures, musics etc. influencing the audience and making his/her emotions revealed should be used. It is important that the interaction of the audience and the story is enabled (Robin, 2008).

Economy: The most difficult of the components within digital story creation process is the economy element. In this step, sufficient contents should be included in order to tell the story. It is quite important to avoid from unnecessary details. The content intended to be told should be created in a short and clear way without boring the audience (Bull & Kajder, 2005).

An Effective Dubbing: An effective dubbing enables story to be understood better and gives further meaning to the story. In this step, it is important that voice tone is set properly and the voice is used clearly. Because an effective dubbing is one of the most important components contributing to the efficiency of digital story (Keleş, 2019).

Power of the Music: Determining the music suitable for the script of the story is an important element in order to beautify, support the story and make the story gain depth. One should be careful while determining the music; the determined music should be in relation with the theme of the story and with the message wanted to be told (Robin, 2008). The lyrics of the music in the story should be paid attention as well. The background music lyrics may cause problems in conveying the message in the story to the audience (Sarıtepeci,2016).

Rhythm: Another element digital story should have is rhythm. It is also expressed as the speed of the pace or the speed control (Robin, 2008). The speed of the prepared story should be neither very fast nor very slow. Audience

should be able to follow the story in a proper rhythm. The rhythm of the story should be set in a way which will be able to attract the attention of the audience and which is suitable for the theme (Sarıtepeci, 2016).

Steps of Digital Story Creation

The process of digital story creation is comprised of specific steps. While these steps do not have a determined standard, digital story creation process prepared by various researchers displays similarities (Jakes & Brennan, 2005; Robin, 2008).

In this study, the steps which construct digital story creation process according to Jakes and Brennan (2005), are used. Jakes and Brennan (2005) listed digital story creation process in six steps: writing, script, storyboarding, locating multimedia, creating digital story and sharing digital story.

Writing: In the writing step, the theme in digital story should be determined at first. Realistic or fiction-based stories are written in relation with the theme determined. More than one story essays are conducted. It is important that the story script is written in a way to attract the interest and the attention of the audience. A well written digital story is one of the most important elements setting forth the effectiveness of the story (Kajder, 2004; More, 2008; Xu, Park & Baek, 2011).

Script: After writing step, necessary layout about the story is completed. It comes to script development step. By creating various scripts, attraction of the story is tried to be increased.

Storyboarding: As well as storyboarding can be developed on paper, various programs and online instruments (storyboardthat.com etc.) can also be used (Sarıtepeci, 2016). In this step; where, when and how to use such multimedia instruments as image, picture, sound, music, video, etc. suitable for the selected script are determined. Digital story is lay out in a way to be able to control and organize the script flow. This step during which the screening time of the story scenes are determined is a planning process.

Locating Multimedia: In this step, multimedia instruments like image, picture, sound, music, video etc. which are suitable for the theme of the story, characters it includes and the content are located. Necessary locating which is indicated in the storyboard is conducted to the multimedia instruments to be used in digital story. While multimedia instruments can be created in such ways as computer, camera, dubbing device etc., they can also found in internet environment (Yılmaz, Üstündağ & Güneş, 2017).

Creating Digital Story: Digital story creation process starts via story script and storyboard. In this process, video organizer programs like Movie Maker, Photo Story or online instruments can be used. Selected multimedia

instruments are located into digital story creation program in the way they were determined and at the position they were located during storyboarding step. Many layout like transition time and effects of the placed multimedia instruments, the music inserted to background and dubbing are conducted in this step.

Sharing Digital Story: In sharing digital story step, designer of the digital story can share it with others in classroom environment, face to face or in online environment. Sharing of it in online environment may increase the mass that can access to digital story (Jakes & Brennan, 2005; Yılmaz, Üstündağ & Güneş, 2017). When the study on digital stories is started, it is expressed that knowing the steps of digital story creation will be beneficial in digital story creation process (Robin, 2008).

2.3. Digital Story Types

Digital stories are used for different purposes and in different types. Digital stories are divided into three as personal, historical and informative stories (Robin, 2008). Digital story types are explained respectively as follows:

Personal Stories: They are the stories in which persons tell the events and the topics they attach importance in their own lives. These stories are;

a) Character stories: they are the stories, which are also named as commemoration, about an important person in life.
b) Adventure Stories: they are the stories about the adventures and the happening events in life.
c) Success Stories: they are stories about gained successes.
d) Stories of a place in life: they are the stories about and important place in life.
e) Other Stories: love stories in life, invention/discovery stories, imaginary/fiction stories etc.

Stories About Historical Events and Topics: They are the stories examining the events, persons and societies in order to understand and tell the issues in history.

Informative Stories: They are the stories created for the purpose of informing audience or students about a specific topic, concept or application.

2.4. Digital Story and Adult Education

Primitive men transferred their knowledge, tradition and cultural values by telling stories (Kulla-Abbott, 2006). Since it emerged, storytelling is regarded as an educational instrument. In order to correlate technology with learning-teaching process, digitalized world make digital storytelling become an important instrument beginning from preschool reaching to adult education (Duman & Göcen, 2015; Özpınar, 2017). It is necessary to know the

knowledge, concept and theories told about the subject in digital story process and to use these knowledge within the process. It should be planned that these knowledge is applied through suitable strategy, method and techniques in accordance with the target audience to whom digital story will be told (Pamuk, Ülken & Dilek, 2012). Many studies conducted in the literature set forth that digital storytelling method has positive effects on students. It can be said that digital storytelling method has the quality to meet today's educational needs. It is observed to more actively include students into educational environment in learning-teaching process. Since students are active in digital story creation process, it can be said that it develops their critical thinking skills, study and creative writing skills and technological literacy (Dogan & Robin, 2008). When these positive contributions are taken into consideration in terms of students, it is thought that usage of digital storytelling method also in adult education will contribute to teaching process (Pekyürek et al., 2023).

2.5. Digital Parenting

Parents are mother and father who are as well as biologically responsible for growing up the child, who are also responsible for enabling him/her to grow up in psychological terms. It can be argued that parenting role is one of the most important roles of women and men. Couples having children adopt important responsibilities through parenting role in physical, psychological and social development of the child, supporting and guiding their education, enabling him/her to adopt positive attitudes and behaviors. Different roles await parents in each environment and situation children encounter. Advancements in technology brings together changes in societies and individuals, in this point roles to be undertaken by the parents also changes (Yurdakul et al., 2013). In digitalized world; individuals in the society, particularly children and youngsters do not know what kind of a relation they should have with technology. Responsibilities and roles of parents differentiate in digitalized world (Yaman, 2018).

Role of the parent in digital era is not introducing technology to child and enabling him/her to access to it. Benefiting from the opportunities in digital environment, children's and youngsters' uncontrolled use of technology leaves them alone with various risks and dangers. One of the responsibilities to be undertaken by parents is the protection of children from the problems in digital environment and raising awareness of them. At this point, the indicated responsibility and the role is concept of digital parenting (Canbek & Sarıoğlu, 2007).

In digitalized world, while technology has positive aspects, opportunities; it also has negative aspects and risks (Yildiz Durak & Avcı, 2022; Yildiz Durak & Saritepeci, 2020). Important and key roles go to parents to care for the children who are not aware of these risks and who encounter risks (Yurdakul et al., 2013). However, it is

observed that parents are not aware of digital parenting roles. It can be said that parents adopt an extremely free role by not being able to maintain the control about children's technology use and spending excessive time in digital environment. Such parenting approach and children's uncontrolled technology use cause domestic communication problems.

In the study conducted by Güngör (2014), moreover, it is indicated that family members themselves and children use technology in an uncontrolled way, and child regard technology as a parental responsibility. It is mentioned that this situation will cause deterioration in physical and psychological health of the child (Ateş & Durmuşoğlu-Saltalı, 2019; Çakır, 2013). In another study conducted by Çevik and Çelikkaleli (2010), it is indicated that children of the parents who display uncaring and uncontrolled attitudes have higher technology usage and addiction rates compared to the children of the parents who display an authoritarian attitude which maintains necessary control, which is democratic, protective and in full control. However, in the study conducted by Çalışkan and Özbay (2015), it is indicated that the parents who mostly display an extremely authoritarian attitude, completely forbid use of digital instruments in order to protect their children from negative aspects of technology. In this situation, moreover, it is emphasized that problematic usage is increased by children's use of technology while parents are unaware.

It is observed to be not possible that children and youngster are kept away from digital environments in this era. It is necessary that the parents notice that digital world is an indispensable element in their own lives and in their children's lives. In the same time, it is important that parents adopt digital parenting role (Atman-Uslu & Yildiz-Durak, 2022). When the concept of "Digital Parenting" in the literature is reviewed, Huang et al. (2008) identified it as the protection in digital environment, monitoring and managing child's internet use, finding knowledge and source in line with their needs and having communication. Yurdakul et al. (2013), moreover, identified digital parenting as the individual who behaves according to the needs and expectations of digital era, who have basic or intermediate level of technological literacy, who is aware of the benefits digital environment provides, who is able to protect oneself and his/her children against risks and threats of digital environment, who behaves respectfully in digital environment as well and who is model for his/her children, and who does not quit following the advancements in digital world. In the same time, they classified digital parenting as digital literacy, being aware, ethics, innovativeness and control (Yurdakul et al., 2013).

3. Method

3.1. Research Model

In this research, qualitative and quantitative research methods were used together. The research is designed with mixed method research model. In the quantitative dimension, experimental design was applied; in the qualitative dimension, however, interviewing was utilized. Within content of this research, for the preferred mixed method, the explanatory sequential mixed methods design developed by Creswell and Creswell (2017) was taken into consideration. According to this design, at first quantitative data are collected and analyzed in the research, and then the data is collected by determining the participants of the qualitative research. Finally, qualitative data is related with the quantitative data by analyzing the qualitative data (Creswell & Creswell, 2017). The methodological process in this research is also graded as the collection of quantitative and qualitative data (See Table 1).

Table 1.

Experimental design

Group	Task	Assignment Type	Used Tools / Application	Pretest	Posttest
G1- *Experimental group*	Experiment	Random assignment	Digital Story	O1.1. Personal Information Form O1.2. Digital Parenting Attitude Scale O1.3. Media and Technology Usage and Attitudes Scale	O2.1. Personal Information Form; O2.2. Digital Parenting Attitude Scale; O2.3. Media and Technology Usage and Attitudes Scale O2.4. Semi-Structured Interview Form
G2- *Control group*	Control	Random assignment	Content Presentation Videos	O1.1 O1.2 O1.3	O2.1 O2.2 O2.3

In the quantitative dimension of the research, pretest and final test control grouped quasi-experimental design was adopted as the model of the research. In the qualitative dimension of the research, pretest and final test control grouped quasi-experimental design was adopted as the model of the research. In the qualitative dimension of the research, data was collected from all the participants taking part in the experimental group through the semi-structured interview form. With application of the qualitative data only to the experimental

group, collection of parents' opinions about the use of digital story was aimed within context of the main objective of the research. The results reached through quantitative data was tried to be explained through qualitative data.

3.2. Participants

Participants of the research is composed by 40 parents who are from Bartın city and have different socio-economic characteristic, and whose children are elementary and secondary school students at Science and Art Centre. While determining the sampling; among the sampling methods which are not based on possibility, purposeful sampling method was used. In purposeful sampling, the researcher selects the suitable sampling himself/herself for the aim by considering various criterion situations (Arslantürk, 2008). In selection of the participants of the research, parents who are from Bartın city and whose children are elementary and secondary school students at Science and Art Centre were preferred because of such reasons as simple communication opportunities, availability of the computer classroom, lesson hours of the students at the school being during evening, convenience of parents' work hours, etc. Study (21) and control(21) groups were created through random method within the participants. 42 parents were participated voluntarily to the study; however, two parents who work as nurse and 112(emergency like 911 in USA) staff as 2 scales were not included to the evaluation because they could not fill in the final test due to their intense work tempo in fight with Covid-19. For this reason, the data collected from 40 parents were used in the study.

3.3. Data Collection Instruments

Personal Information Form

It was prepared by the researcher. In 6-item first part of this form, participants were asked to reply their gender, age, educational status; gender of their child, the school child attends to and the parental status towards the child. In the second part asking internet and technology usage statuses, moreover, there are totally 3 items.

Digital Parenting Attitude Scale

As the first data collection instrument utilized in this study, it is the scale titled "Digital Parenting Attitude Scale" which was used in order to reveal digital parenting attitudes. This scale was developed by İnan-Kaya, Bayraktar and Yılmaz (2018). The scale is composed of 13 items, moreover, it is replied through five-Likert (Strongly Agree, Agree, Neutral, Not Agree, Strongly Not Agree) scaling. The scale's Cronbach's alpha coefficient calculated within frame of this study is 0.971.

Media And Technology Usage and Attitudes Scale

As the second data collection instrument utilized in this study, it is the scale titled "Media and Technology Usage and Attitudes Scale" which was used in order to reveal media and technology attitudes. This scale was developed by Özgür (2016). The scale is composed of 60 items in total. The first part comprises 40 items related with smartphone usage, social media usage and social media sharing, making online calls, email, short messages, watching video, playing game, phone call and watching television; it is replied through ten-item (never, once in a month, several times in a month, once in a week, several times in a week, once a day, several times a day, once an hour, several times an hour and every time) scaling. The second part, moreover, is composed of 5 items; it is related with making friends in internet environment and social media friendship, it is replied through the options as 0 to 751 friends or more. The third part, on the other hand, is composed of final 15 items; it is replied through five-Likert ("5-Strongly Agree, 4-Agree, 3-Neutral, 2-Not Agree, 1- Strongly Not Agree") scaling.

Semi-Structured Interview Form

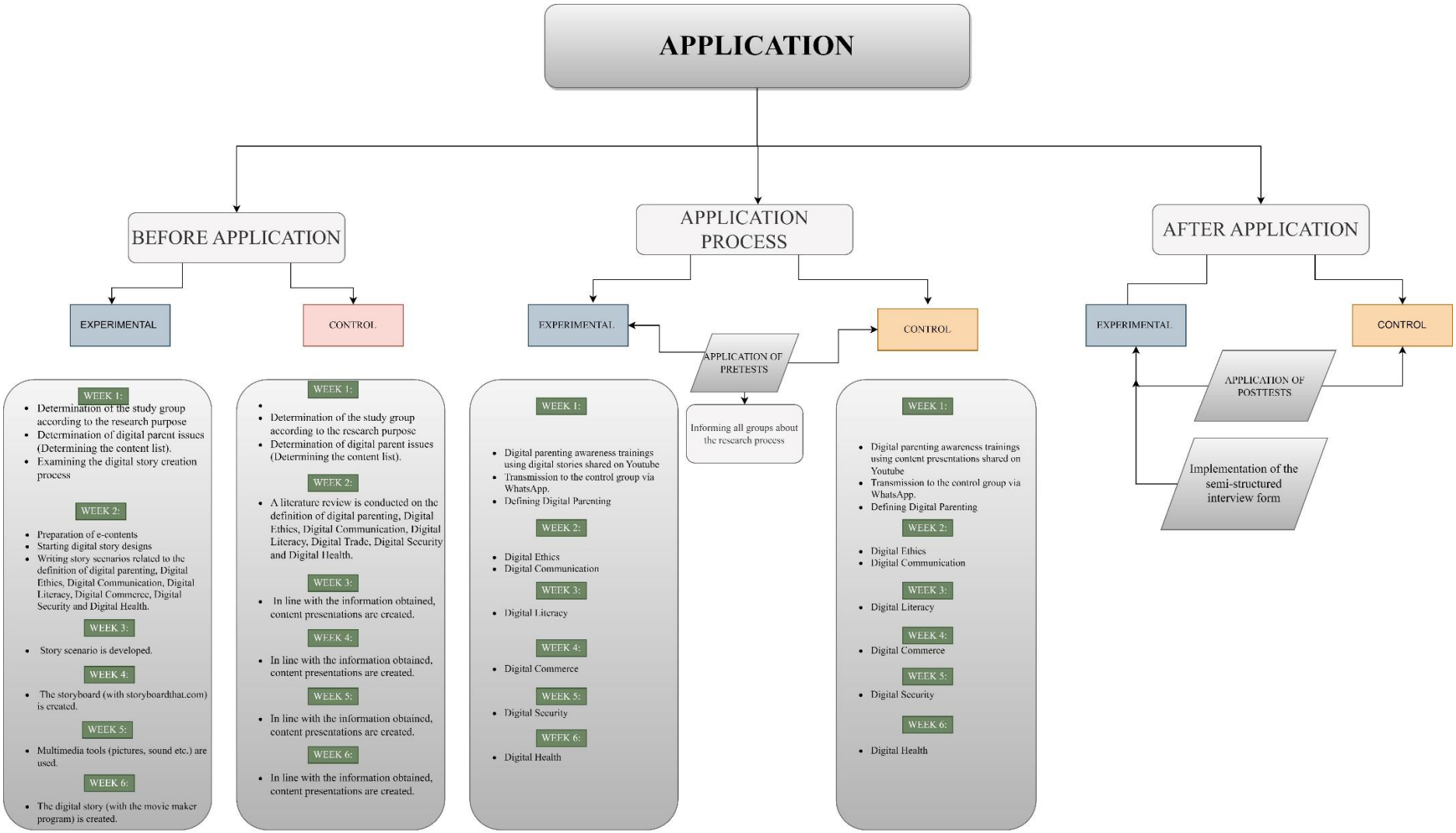
In order to reveal the contributions of digital story activities about digital parenting to the parents, semi-structured interview form was prepared by the researcher. Semi-structured interview form is composed of 7 open ended questions. In this form, there are 6 open ended questions about digital story activities and 1 question about digital parenting awareness. Semi-structured interview form is organized by consulting expert opinions.

3.4. Application

In this part; studies which were attained throughout the application process; pre-application, during the application and post-application studies were included. These parts were summarized in Figure 1.

Figure 1.

Studies Before, During and After Application in the Research



Pre-Application

In the research, pre-application training content of the experimental group and the control group was prepared. Designing of e-materials through which the prepared educational content will be presented was started. For the experimental group, digital stories in compliance with the content were designed. For the control group, moreover, content presentations were created. Pre-application studies were presented in annexes Table A and Table B. According to the content list presented in Table A, application contents of study and control groups were accomplished. Creation process of the education content which will be given to study and control groups was presented in Table B. In line with the process presented in Table B, the researcher prepared digital storytelling activities and presentation contents. In this study, the steps structuring digital story creation process according to Jakes and Brennan (2005) were used. Jakes and Brennan (2005), listed digital story creation process in six steps: writing, script, storyboarding, locating multimedia, creating digital story and sharing digital story. The operations done in digital story creation process are explained in detail as follows.

Writing**:** Subjects of the stories are determined based on the educational content list which will be provided in order to develop digital parenting competence. Primarily, stories in harmony with the subject content were written on paper.

Scripting**:** Necessary editing operations were done on the written stories. By developing scripts, attention is drawn to the main theme in the story.

Storyboarding: While creating storyboards, online instruments were utilized. By utilizing Storyboardthat.com site, multimedia instruments (image, sound, etc) suitable for the script were selected.

Locating Multimedia: Multimedia instruments (image, sound, video, etc) suitable for the characters and the events in the story were selected. In compliance with the storyboard; arrangements like dubbing, image, content, etc. were done.

Creating Digital Stories: Based on the story script, digital story creation process was started. All selected multimedia instruments like picture, sound, music, etc. were located to Movie Maker video arrangement program based on the storyboard. Such proceedings were done like firstly locating scenes (storyboards), then dubbing of the scenes and lap dissolves. After attained arrangements, digital story is recorded as video. Digital story and video presentation examples developed in the process are presented in the appendix section.

Sharing Digital Story: Digital stories were shared with the participants every week via YouTube during the application process. Created digital stories were shared with the experimental group in the application process after pretest was done.

Application Process

Pretest Application: Nearly one week before the application process starts, "Digital Parenting Attitude Scale" and "Media and Technology Usage and Attitude Scale" were applied to the applicants in online environment. Application of the pretest started in the same time period for the study and the control groups and it lasted nearly one week.

Sharing Digital Story with the Experimental group: Application process of the research was attained during the second semester of 2019-2020 academic year for 6 weeks with attendance of the parents whose children are elementary and secondary school students in Bartın Science and Art Centre. By foreseeing the fact that it is not possible to collect all parents together in the same day and time during the application step, online application was preferred. Study and Control Group participants created two different WhatsApp groups. For six weeks, the videos shared in YouTube were forwarded via WhatsApp. Digital stories were shared respectively based on developing digital parenting competence training program which was created beforehand.

Sharing Content Presentations with the Control Group: Content presentations were shared with the control group in line with developing digital parenting competence training plan. Content presentations continuing for six weeks were also shared in YouTube and forwarded to the participants via WhatsApp. In name of achieving interaction with the participants in WhatsApp group, question answer and discussion methods were utilized.

Post-Application

Application of the Final Test: During the week after the application, "Digital Parenting Attitude Scale" and "Media and Technology Usage and Attitudes Scale" were applied to the participants in the study and the control groups in online environment.

Semi-Structured Interviews: Following the final test, semi-structured interview form was applied to the experimental group participants. By directing 7 questions to the participants, data were collected in the name of examining the contribution of digital storytelling activities to digital parenting attitude development.

3.5. Data Collection and Analysis

Executing online interviews with the participants, information about the study was given. Data collection instruments were applied to the participants in online environments. In this study, quantitative and qualitative research methods were used together.

In the quantitative part of the study, data were collected through the application of "Digital Parenting Attitude Scale" and "Media and Technology Usage and Attitudes Scale" to the participants. The quantitative data gained from the study and the control groups were primarily analyzed. For the analysis of the quantitative data, SPPS 22 (Statistical Package for Social Sciences) program was utilized.

The qualitative data in the study were gained from semi-structured interview form which the participants replied in the final test of the experimental group. For the evaluation of the qualitative data, content analysis method was utilized. Coding of the qualitative data was done together with a second coder.

4. Findings

In this part, the results gained in the research were listed respectively and these results were tried to be examined by comparing with similar studies.

4.1. Findings on the First Sub-Question

To find the reply for this sub-question, arithmetic mean and standard deviation were utilized. Related findings were presented in Table 2.

Table 2.

Parents' digital parenting attitude and media and technology usage and attitude pretest and posttest scores.

Scale	Group	N	Pretest		Posttest		Difference
			$\bar{x}$	Sd	$\bar{x}$	Sd	(Posttest-Pretest)
Digital Parenting Attitude Scale	Experiment	19	49.4737	6.23047	49.6316	4.37430	0.1579
	Control	21	47.4286	3.89322	46.5238	5.15382	-0.9048
Media and Technology Usage and Attitudes Scale	Experiment	19	262.9474	51.08541	265.9474	56.53364	3.0000
	Control	21	272.0000	58.16356	280.4762	69.54468	8.4762

When the Table 2 was examined and when the scores collected from the study and the control groups for digital parenting attitude scale were reviewed, it was observed that there was increase in the attitude scores of the experimental group after calculation (gap= 0,1579); there was decrease, moreover, in attitude scores of the control

group (gap= -0,9048). When the scores of the study and the control groups for media and technology usage and attitude scale were examined, it was observed that there was increase in usage and attitude scores of the study and the control groups after calculation (gap= 3,0000; 8,4762).

4.2. Findings on the Second Sub-Question

In order to find the reply of this sub-question, ANCOVA was utilized. Related findings were presented in Table 3.

Table 3.

ANCOVA results regarding the difference between the experiment group and the control group's digital parenting attitudes.

Group	$\bar{\chi}$	Adj. Mean	Source	Sum of Squares	df	Mean Squares	F	p	Partial Eta Squared
Experiment	49,631	49,390	Pretest	119,111	1	100,048	5,668	,023	,136
			Method	25,879	1	25,879	1,231	,274	-
			Error	756,544	36	21,015			
Control	46,523	47,034	Total	93132,000	40				

As it was observed in Table 3, statistically there was not a meaningful difference between final test scores of digital parenting attitudes which were edited based on the pretest scores of the groups ($F(1\text{-}36)= 1.231$, $p>0.05$). Within this context, it can be said that digital parenting attitude scores of the parents participating to the study did not change at meaningful level based on the experimental calculation.

4.3. Findings On the Third Sub-Question

To find the reply of this sub-question, ANCOVA was utilized. Related findings were presented in Table 4.

Table 4.

ANCOVA Results Regarding the Difference Between the Experiment Group and the Control Group's Media and Technology Usage and Attitudes.

Group	$\bar{X}$	Adj. Mean	Source	Sum of Squares	df	Mean Squares	F	p	Partial Eta Squared
Experiment	265.9474	269.209	Pretest	57104.693	1	57104.693	21.826	.000	.377
			Method	28.588	1	28.588	.011	.917	-
Control	280.4762	277.256	Error	94188.854	36	2616.357			
			Total	3150095.000	40				

As it was observed in Table 4, statistically there was not a meaningful difference between groups' media and technology usage attitudes final test scores which were edited based on pretest scores (F(1-36)= 0,11, p>0.05). Within this context, it can be said that media and technology usage and attitudes scores of the parents participating to the study did not change at meaningful level based on the experimental calculation.

4.4. Findings on the Fourth Sub-Question

In order to find the reply of this sub-question, ANOVA and T-test were utilized. T-test was utilized in order to determine whether digital parenting attitude and media and technology usage attitudes of the parents differentiate meaningfully based on gender. Related findings were presented in Table 5.

Table 5.

T-test Results of Parents' Digital Parenting Attitude and Media/Technology Usage and Attitude Scores By Gender.

Scale	Gender	N	$\bar{X}$	SD	t	df	p
Digital Parenting Attitude	Female	31	48.2581	5.10534	0.626	38	0.541
	Male	9	47.1111	4.75511			
Media and Technology Usage and Attitudes	Female	31	264.4194	65.26090	-2.104	38	0.049
	Male	9	305.1111	46.15854			

According to Table 5, it was observed that parenting attitude scores of women parents ($\bar{X}$=48,26; SS=5.11) were higher compared to men parents ($\bar{X}$=47,11; SS=4.76). Media and technology usage and attitude scores of men parents ($\bar{X}$=305.11; SS=46.16), moreover, were higher compared to women parents ($\bar{X}$=264,42; SS=65.27). When T-test results were reviewed, while there was not a meaningful differentiation between digital parenting attitude scores of the parents based on gender (t=0,626; p >0,05); statistically there was a meaningful difference between media and technology usage and attitude scores (t= -2,104; p <0.05).

T-test was utilized to determine whether digital parenting attitude and media and technology usage and parents' attitudes differ meaningfully based on the gender of their child. Related findings are presented in Table 6.

Table 6.

T-test Results of Parents' Digital Parenting Attitude and Media/Technology Usage and Attitude Scores by Their Children by Gender.

Scale	Gender of their child	N	$\bar{X}$	SD	t	df	p
Digital Parenting Attitude	Female	18	48.0000	5.30261	0.00	38	1.00
	Male	22	48.0000	4.85014			
Media and Technology Usage and Attitudes	Female	18	262.4444	74.82625	-0.971	38	0.340
	Male	22	282.6818	52.15671			

According to Table 6, it was observed that digital parenting scores of the parents having girl and boywere equal ($\bar{X}$=48,00). Media and technology usage and attitudes score ($\bar{X}$=282,69; SS=52,16) of the parents who have boywere higher compared to the score ($\bar{X}$=262,44; SS=74,83) of the parents having girl. When T-test results were observed, there was not a meaningful difference between digital parenting attitude scores of the parents based on children's gender (t=0,00; p >0,05). Similarly, there was not a meaningful difference based on media and technology usage and attitudes score as well (t= -0,971; p >0.05).

ANOVA test was utilized to determine whether digital parenting attitudes and media and technology usage and attitudes of parents differentiate meaningfully based on daily frequency of technology usage. Related findings were presented in Table 7.

Table 7.

Descriptive Statistics Based on Daily Technology Usage Frequency and ANOVA Test Results According to The Daily Frequency of Technology Use.

Scale		N	$\bar{X}$	SD		Sum of Squares	sd	Mean Squares	F	p
Digital Parenting Attitude	1-3 hours	18	48.9444	5.94556	Within groups	29.608	2	14.804	.581	.564
	4-6 hours	15	47.1333	4.13809	Between groups	942.392	37	25.470		
	7-9 hours	7	47.4286	4.11733	Total	972.000	39			
	Total	40	48.0000	4.99230						
Media and Technology Usage and Attitudes	1-3 hours	18	265.1667	65.93334	Within groups	3114.513	2	1557.257	.376	.689
	4-6 hours	15	276.3333	69.49272	Between groups	153249.262	37	4141.872		
	7-9 hours	7	289.2857	44.22938	Total	156363.775	39			
	Total	40	273.5750	63.31925						

According to Table 7, digital parenting attitude score of the parents who daily use technology for 1-3 hours were higher ($\bar{X}$=48.94; SS=5.95) compared to scores of other groups. Digital parenting attitude score of the parents who daily use technology for 4-6 hours, moreover, was lower ($\bar{X}$=47.13; SS=4.14) compared to other groups. Media and technology attitude scores of the parents who daily use technology for 7-9 hours were higher ($\bar{X}$=289.29; SS=44.23) compared to other groups. Media and technology attitude score of the parents who use technology daily for 1-3 hours was lower ($\bar{X}$=266.17; SS=65.93) compared to other groups. It was observed that digital parenting attitude scores of the parents do not differentiate meaningfully based on their daily frequency of technology usage (F(2-37)=0,581; p>0.05). Media and technology usage attitude scores of the parents also do not differentiate (F(2-37)=0,376; p>0.05) meaningfully based on their daily frequency of internet usage. T test was utilized to determine whether digital parenting attitude and media and technology usage attitudes of parents differentiate meaningfully based on age. Related findings were presented in Table 8.

Table 8.

Descriptive Statistics by Age Levels and T-Test Results According to Age Levels.

Scale	Age	N	$\bar{x}$	sd	t	df	p
Digital Parenting Attitude	20-35	12	48.65	4.90516	0.556	38	0.584
	36-50	28	47.72	5.09071			
	Total	40	48.00	4.99230			
Media and Technology Usage and Attitudes	20-35	12	257.42	61.06994	-1.079	38	0.292
	36-50	28	280.50	64.07837			
	Total	40	273.58	63.31925			

According to Table 8, digital parenting attitude score of the parents aged between 20-35 were higher ($\bar{X}$=48.65; SS=4,9) compared to the parents from other age groups. Media and technology usage and attitudes score of the parents aged between 36-50 were higher ($\bar{X}$=280,50; SS=64,08) than the score of the parents from other age groups. It was observed that digital parenting attitude score of the parents do not differentiate meaningfully (t=0.556; p>0.05) based on age. Media and technology usage and attitude scores also do not display meaningful difference (t=-1.079; p>0.05) based on parents' gender.

4.5. Findings On the Fifth Sub-Question

The data gained through the semi-structured interview form to find reply to this question were analyzed via content analysis method. During the data analysis, 25 codes and 5 themes were created.

Contributions of Digital Story Activities: Participants' Opinions were consulted through directing the questions "Did Digital Story Activities About Digital Parenting Make Contribution to You? What were The Contributions of Digital Story Activities About Digital Parenting to You?". In this theme, contributions of digital story activities to the participants were presented in Table 9.

Table 9.

Contributions of Digital Story Activities.

Theme	Codes	f
Contributions of Digital Story Activities	Embody and memorize information	3
	Gaining digital literacy	5
	Realizing the risks in digital environment	3
	Reminding of old information	3
	Realizing that you have wrong information	1
	Getting new information	5

When the opinions of the participants in Table 9 were examined, it was expressed that digital story activities about digital parenting contributed the biggest to enabling adoption of digital literacy (f=5) and new knowledge (f=5). Moreover, it was observed that following this, it contributes to concretizing and enabling the information memorable (f=3), remembering the previous knowledge (f=3) and noticing the risks in digital environment (f=3) respectively. Additionally, it was detected that only one person noticed (f=1) that he/she has wrong information about digital story activities. Some participant opinions are as follows:

(OP4) "It contributed to my motherhood and academic life. I believe that it contributed me to use technology more effectively, more beneficially and in a questioning way. Thank you..."

(OP17) "Noticing that there are some mistakes I did, acquiring information about the issues I did not have idea about and adopting several information about which I can warn my child ."

Effects of Digital Story Activities to Digital Parenting Awareness: In this theme, effects of digital story activities on digital parenting awareness were presented in Table 10.

Table 10.

The Effects of Digital Story on Digital Parenting Awareness

Theme	Codes	f
The Effects of Digital Story on Digital Parenting Awareness	Realizing the online risks children may face	5
	Keeping track of children's technology use	3
	Realize and adopt the role of digital parenting	6
	Learning digital parenting responsibilities	6

When the participant opinions in Table 10 were examined, it was expressed that digital story activities about digital parenting affected digital parenting awareness mostly in terms of noticing and adopting digital parenting role (f=6) and learning digital parenting responsibilities (f=6). It was observed that it affected noticing online risks children may encounter (f=5) and monitoring children's technology usage (f=3) respectfully. Some participant opinions are as follows:

(D18) "As a mother, I realized the significance of my responsibility more clearly."

(D5) "It affected my awareness, I was paying attention already, I gained more information thanks to this activity."

The Most Favored Three Features of Digital Story Activities: In this theme, the most favored three features of digital story activities were presented in Table 11.

Table 11.

The Three Favorite Features of the Digital Story.

Theme	Codes	f
The three favorite features of the digital story	Understandable and easy access	2
	Embody information	3
	Voicing the digital story	4
	Entertaining while training	3
	Visual line characters	6
	Dialogues in the story	5
	Provide brief and concise information	7

When the participant opinions in Table 11 were examined and the most favored features of the applied digital story activities were reviewed, it was expressed that the most liked ones were giving brief and basic information (f=7) and the visual cartoon characters used in digital story (f=6). Following them, other most favored features were dialogues (f=5) and dubbing of digital story (f=4) respectfully. Additionally, it was observed that the participants also liked concretization of the information (f=3) and clear and simple access (f=2) features of digital story activities. Some participant opinions are as follows:

(OP1)"Storifying real life events, authenticity of stories' graphics and dubbing, stories' being not boring."

(OP4)"Up-to-date videos concretized the subject, simplified learning and it addresses to all strata; its being beneficial."

The Most Unfavorable Three Features of Digital Story Activities: In this theme, the most unfavorable features of digital story activities were presented in Table 12.

Table 12.

The Three Most Disliked Features of the Digital Story.

Theme	Codes	f
The three most disliked features of the digital story	Long dialogues	1
	Smallness of the images	2
	The simplicity of the story	1
	Pause in voiceover	3
	Being time consuming	1

When the participant opinions in Table 12 were examined and the most unfavorable features of the conducted digital story activities were reviewed, it was observed that pauses in dubbing (f=3) and smallness of the used images (f=2) come the first. Then the participants expressed that they did not like digital story activities' being

time-consuming (f=1), banality of the story (f=1) and lengthiness of the dialogues (f=1) respectfully. Some participant opinions are as follows:

(OP12) "Pauses and stuck in dubbing, smallness of the images."

(OP4) "Time-consuming to watch and banality of the story."

Improvement Suggestions for Digital Story: In this theme, improvement suggestions for digital story were presented in Table 13.

Table 13.

Suggestions for Improving the Digital Story.

Theme	Codes	f
Suggestions for Improving the Digital Story	Improving images in size	2
	Long dialogues are not included in writing	1
	Improving voice over	4

When the participant opinions in Table 13 were examined and their solution suggestions for improving unfavorable features were reviewed, it was observed that the dubbing (f=4) improvement comes first. Then it was detected that the participants suggest improvement of the images in size (f=2) and unavailability of written presentation of the long dialogues (f=1) respectfully. Some participant opinions are as follows:

(OP12) "Dubbing can be more professional, images can be bigger and following the speech bubbles can be enabled, story can be made more attractive through help of sound effects."

(OP16) "Dubbing and images can be improved."

5. Discussion and Conclusion

In this study, by examining the effect of digital story activities about digital parenting on digital parenting attitudes of the parents, setting forth digital parenting awareness were aimed. In the same time, setting forth technology usage and attitudes of the parents was also aimed. Within context of these targets, analyses were conducted, and the findings were discussed based on sub-questions.

In this study, the digital parenting attitude of the parents increased after the proceedings performed via digital story activities. In the control group, however, there was decrease in attitude scores. In the study they conducted with elementary school teachers and prospect teachers, Göçen-Kabaran et al. (2019) concluded that their attitude scores about giving computer-assisted education did not display a meaningful difference before and after digital

story workshop. However, it was indicated that attitude scores of the participants about giving computer-assisted education displayed increase after the application. Also, in both of the conducted studies, a meaningful differentiation between the attitude scores was not observed. It was remarked that people's attitude resisting to the change is the collection of emotion, opinions, and behaviors. People's attitudes change in a specific time period in line with new information and experiences. Accordingly, change of attitudes may happen as long as the application process lasts for an extended period.

Media and technology usage and attitudes of the parents in study and control groups increased due to the proceedings conducted within frame of the research. In a study conducted by Livingstone et al. (2017), it was reported that technology usage and competence of parents also affects children's technology usage and competence. Within this context, it can be said that media and technology usage and attitudes of parents affect digital parenting attitudes. At the same time, it can be said that parents' digital literacy affects digital parenting attitudes.

It was observed that statistically there was not a meaningful difference between digital parenting scores of parents based on gender. Despite there was not meaningful difference, it was observed that women parents' digital parenting attitude scores were higher compared to men parents. Also in the study conducted by Yaman et al. (2019), differentiation in digital parenting self-efficacy level was not observed based on gender. However, in his doctorate thesis, Yaman (2018) reported that mothers have higher digital parenting self-efficacy perception level based on the parenting role compared to fathers. When the other studies in the literature were examined, it is indicated that housewives have higher digital parenting behavior than working women and fathers (Baker, Sanders & Morawska, 2017; Doğan, 2013; Livingstone et al., 2018). At this point, it can be argued that women's parenting role as a mother, digital parenting attitude, awareness and behaviors are higher.

Statistically a meaningful differentiation was observed in media and technology usage and attitude scores of parents based on gender. Media and technology usage and attitude scores of male parents are higher than women parents. In their study in which they reported EUKO (EU Kids Online II, 2010) findings, Kaşıkçı et al. (2014) also informed that there is a big difference between internet use of men parents and women parents in Turkey. It was reported that while 49% of male parents and only 23,5% of female parents in Turkey use internet, 87% of male parents and 82% of female parents in Europe use internet.

In this study, a meaningful differentiation was not observed in digital parenting scores of parents based on child's gender. It was observed that digital parenting scores of parents having girl and boy children are equal. Also in

the study conducted by Durak (2019), a differentiation was not observed in the parenting mediation for children's internet usage scores of parents based on children's gender. Different from this study, it was observed that parenting mediation scores of the parents having girl children were lower compared to the parents having boy children.

Statistically a meaningful difference was also not observed in media and technology usage and attitude scores of parents based on children's gender. It was found that media and technology usage and attitude scores of the parents having boy children are higher than parents having girl children.

In this study, it was observed that digital parenting attitude scores of parents do not differentiate meaningfully based on daily frequency of technology usage. Digital parenting attitude scores of the parents using technology for 1-3 hours daily resulted higher than the parents using technology more often daily. Also in the study conducted by Baker, Sanders and Morawska (2017), it was indicated that lengthiness or shortness of daily internet usage time does not create a different risk between the families. Also in the study conducted by Durak (2019), it was stated that parenting mediation for children's internet usage scores of parents did not differentiate based on daily frequency of technology usage. On the other hand, it was emphasized that the scores of the parents using technology for 1-3 hours daily are lower than the scores of other parents.

Media and technology usage and attitudes scores of parents also do not differentiate based on parents' daily frequency of technology usage. Media and technology usage and attitudes scores of the parents using technology for 7-9 hours daily are higher compared to other groups. According to the data of Household Information Technologies (IT) Usage Research by TÜİK (Turkish Statistical Institute) (2019), 98,3% of the individuals aged between 16-74 years regard themselves as continues internet users, moreover, 90,8% stated that they use internet almost every day.

In this study, it was observed that digital parenting scores of parents do not differentiate meaningfully based on gender. However, despite there is not meaningful difference, digital parenting attitude scores of the parents aged between 20-35 years are higher compared to the parents aged between 36-50 years. In the study conducted by Durak (2019), it was revealed that parenting mediation scores differentiate meaningfully based on age group of the parents. It was emphasized that the mediation score of the parents in 31 and 40 age groups are high; the mediation score of the parents in 20 and 30 age groups are low. In a study conducted by Eşgi (2013), it was informed that digitally migrant parents regard internet usage of their digitally native children as problematic. At this point, it can be said that digitally migrant parents' excessive generation gap affects parenting attitudes. In his

doctorate thesis, Yaman (2018) indicated that digital parenting self-efficacy perception level decreases as parents age. He underlined that this differentiation is small. In another study conducted by Valcke et al. (2010), it was informed that age of parents affects internet parenting styles.

It was observed that statistically, there is no meaningful difference in media and technology usage and attitude scores of parents based on age. Even there is not a meaningful difference, it was revealed that media and technology usage and attitude scores of the parents aged between 36-50 are higher compared to parents aged between 20-35. Moreover, in the study conducted by Baker, Sanders and Morawska (2017), it was stated that parents' internet usage is related to parents' age. Thus, also in this study and in other studies in the literature, it is observed that difference in media and technology usage decrease based on gender.

In qualitative part of the research, when the contributions of digital story activities about digital parenting applied to the experimental group were examined; the opinion came forth that it contributed most in terms of enabling adoption of digital literacy and gaining new information. However, it was observed that it contributed to digital awareness of parents mostly in terms of noticing digital parenting role and adopting it, learning responsibilities of digital parenting, protecting children from online risks and monitoring children in online environments. When the findings gained through the qualitative study conducted by Atman-Uslu and Yildiz-Durak (2022) were reviewed, the result was reached that digital parenting awareness dimensions of parents were five as productive use of technology, protecting from online risks, being role model, being open to digital ignorance and innovations. The findings in both studies are consistent for each other. Within this context; as digital parenting quality of parents increase, it can be said that they monitor children's behaviors in online environments, they are aware of the risks children encounter and they incline children to use internet safely.

When the most favored three features of digital story activities which emerged as a result of qualitative interviews with parents were reviewed, the result was reached that the most favored features in digital story are giving brief and basic information, used visual cartoon characters and dialogues and the story. According to Digital Storyboarding Centre founders of which are Joe Lambert and Dana Atchley, seven basic components of digital storyboarding are summarized as opinion, a dramatic question, an emotional content, dubbing skill, power of story music, simple content and proceeding speed. Also in this study, it can be said that the features parents liked most are emphasized as brief and basic information and simple content components; dialogues in the story and emotional content component.

When the most unfavorable three features of digital story activities conducted with the parents in the experimental group were reviewed, the result was reached that these are the pause in dubbing, smallness of the used images and digital story activities' being time-consuming. In the study conducted by Rossiter and Garcia (2010) which handles usages of digital story, the result was reached that women participants were indicated to pay attention to digital voice and to the diction (correct usage of the words) at most in digital stories; the majority of the participants creating digital story added their own voices to their stories, they regard this as a learning instrument. In line with this, importance of the sound element in digital story activities has emerged once again.

Among the solution suggestions by parents to improve unfavorable features of digital story activities, the most suggested ones were determined as improvement of dubbing, improvement of images in size and written presentation of long dialogues. Also, in the qualitative study conducted by Uslupehlivan et al. (2017), prospect teachers reported their improvement suggestions for digital stories as preparation of visual and auditory elements more elegantly and the written parts in the story to be brief and short. The qualitative data in these two studies are consistent with each other. For a digital story to be successful, the content needs to be brief and short, and images and auditory elements need to be in harmony with the script.

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Ethical Declaration

All procedures performed in studies involving human participants were in accordance with ethical standards. The study was approved by the Bartın University Social Sciences and Humanities Research Ethics Committee (Protocol number: 2020-SBB-098).

Conflict Interest and Author Contributions

- First author have made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data.

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Examination of Postgraduate Theses in the Field of Music Technologies in Turkey Between 2018-2022

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ABSTRACT

The development of technology affects human life and interests in many areas. This research was carried out to classify the postgraduate theses in the field of music technologies covering the years 2018-2022 in Turkey in order to reveal the effects of technological developments on music. Since the specified time period includes the Covid-19 pandemic period, it is among the sub-objectives of the research to determine the situation as a leading indicator of the effect on the thesis studies. The research is a descriptive study from qualitative research methods. The content and scope of the research consist of a total of 31 postgraduate theses that can be accessed on the thesis screening page of the Council of Higher Education between 2018-2022. In the thesis studies reached for the research, the concepts related to music technologies included in the keywords, subject headings, and abstracts of the theses constitute the limitations of the research. Although these concepts include the expressions "Computer, technology, sound recording, digital, recording technologies, sound technologies, music technologies, studio, software", the ones related to the field of music have been scanned. The data obtained were classified according to academic degrees, years, universities, institutes, subjects, the language in which they were written, and thesis titles and were analyzed by making frequency/percentage distributions. Based on the data obtained, it was concluded that the master's theses in the field of music technology are in the majority, the studies are based in Istanbul, and the Social Sciences Institutes are dominant based on the institute. It is thought that the research is important in terms of creating a leading indicator for the studies to be done in the field of music technologies.

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Türkiye'de 2018-2022 Yılları Arasında Müzik Teknolojileri Alanında Yapılmış Lisansüstü Tezlerin İncelenmesi

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ÖZET

Teknoloji gelişimi birçok alanda insan hayatına ve ilgi alanlarına etki etmektedir. Bu araştırma, teknolojik gelişmelerin müziğe olan etkilerini ortaya koyabilmek adına, Türkiye'de 2018-2022 yıllarını kapsayan, müzik teknolojileri alanındaki lisansüstü tezlerin sınıflandırılması amacıyla yapılmıştır. Belirtilen zaman periyodu Covid-19 pandemi dönemini de içerdiği için yapılan tez çalışmaları üzerinde etkisinin, öncü gösterge niteliğinde durum tespitini yapmak, araştırmanın alt amaçları arasındadır. Araştırma nitel araştırma yöntemlerinden betimsel bir çalışmadır. Araştırmanın içerik ve kapsamını; 2018-2022 yılları arasında YÖK tez tarama sayfasında erişilebilen toplam 31 lisansüstü tezleri oluşturmaktadır. Araştırma için ulaşılan tez çalışmalarında, tezlerin anahtar kelimelerinde, konu başlıklarında ve özet kısımlarında yer verilen müzik teknolojilerine ilişkin kavramlar, araştırmanın sınırlılıklarını oluşturmaktadır. Bu kavramlar 'Bilgisayar, teknoloji, ses kayıt, dijital, kayıt teknolojileri, ses teknolojileri, müzik teknolojileri, stüdyo, yazılım' ifadelerini içermekle birlikte, müzik alanı ile ilişkili olanlar üzerinden tarama yapılmıştır. Elde edilen veriler akademik derecelere, yıllara, üniversitelere, enstitülere, konulara, yazıldığı dile ve tez başlıklarına göre sınıflandırılmış, frekans/yüzde dağılımları yapılarak incelenmiştir. Elde edilen verilerden yola çıkılarak müzik teknolojisi alanında yüksek lisans tezlerinin çoğunlukta olduğu, çalışmaların İstanbul merkezli olduğu ve enstitü bazında Sosyal Bilimler Enstitülerinin ağırlıklı olduğu sonuçlarına ulaşılmıştır. Araştırmanın, müzik teknolojileri alanında yapılacak çalışmalara öncü gösterge oluşturma bakımından önemli olduğu düşünülmektedir.

1. Introduction

In today's information age, keeping up with the rapidly developing world and adapting to the innovations brought by science and technology is one of the basic elements of social development. Technology developed to meet the needs and desires of the society is one of the determinants of the competitive advantage of nations. Technology is defined as a phenomenon that covers all of the tools, equipment and methods used in this process, making life easier during practicality and general life in studies conducted in many fields (Delikara, 2019: 2). The art of music, in all its dimensions, has been in a strong relationship with technology in every period of human history. Technological developments have led to important developments by applying them to every field of music art.

The meeting of technology elements with the art of music is expressed with the concept of "music technologies" (Chadabe, 1997:1). Music technologies is an interdisciplinary and multidimensional concept that includes all stages of sound production, synthesis, recording and reaching the listener. In this context, we can say that the history of music technology includes innovations in tonal systems, the design of musical instruments, studies in the acoustic field, and discoveries about perspectives and ideas in the field of music-sound.

The interest in this field is constantly increasing with the development of the internet and social media and the effect of sharing and training on music and technologies. Say gathered the subject of computer and music under the headings of recording, composition and computer, notation writing, music education, digital dissemination of music from the internet, access to music materials, personal websites, music listening, and talked about the practical benefits of the relationship of music and computer technologies with the internet in reaching music to consumers. (Say, 2005).

"Measurement and analysis methods, which are a must for music technology education, especially when combined with today's computer technology, open the door to many different advanced research areas. Thus, an interdisciplinary systematic whole is formed for music technology" (Işıkhan, 2013).

The use of technology in the field of music has increased over time and gained various dimensions, and the studies carried out in this context are now gathered under the name of "Music Technology". The combination of music and technology elements has led many composers to work on this field. The term music technology is mostly used to cover electromechanical, electro-acoustic, mechanical and electronic technologies (Malm, 1992: 349).

It should not be forgotten that information pollution increases as well as ease of access to information. In order to prevent this information pollution, the importance of academic studies, especially thesis, which is done or will be done in universities, is increasing. In recent years, it is seen that academic studies on music technology have decreased compared to before 2018. It should not be forgotten that the effects of COVID-19 may also be among the reasons for this. In studies conducted in the field of music technology, a research article in which postgraduate theses were classified similarly between 1996 and 2018 was found through a literature review (Delikara, 2019). In this continuation study, it is aimed to reveal the current status of the classification, which is again in the nature of determining the situation and on the basis of the year. Looking at the last 5 years since 2018, it has been observed that there has been an increase in the variety of subjects of postgraduate theses compared to previous years.

Within the scope of the research, 31 postgraduate theses in the field of music technologies were taken as data.

2. Methodology

In the study, the survey model, which is a suitable method for determining the situation, was adopted. Survey models are research models that describe a past or present situation as it is (Karasar, 1999: 77). Description is the first step in all branches of science; Its purpose is to identify, classify and record the facts of the research and the relationships between these cases" (Yıldırım, 2000: 56). According to this model, data were collected for 2018 and beyond, using the thesis archive page of the Higher Education Council (YÖK) website (http//www.yok.gov.tr). Totally 31 postgraduate theses have been reached and shown in Appendix -1.

The problem sentence of the research is "What are the postgraduate theses in the field of Music Technologies in Turkey and how is their distribution by years?" Sub-research questions:

1. How is the distribution of postgraduate theses written in the field of music technologies according to academic degrees?
2. What is the distribution of post graduate theses written in the field of music technologies by years?
3. How is the distribution of postgraduate theses written in the field of music technologies according to languages?
4. How is the distribution of postgraduate theses written in the field of music technologies according to institutes?
5. How is the distribution of postgraduate theses written in the field of music technologies according to universities?

6. How is the distribution of postgraduate theses written in the field of music technologies according to their subjects?

3. Findings

3.1. Findings Related to the First Sub-Problem

The distribution of theses by academic degree is given in Table 1.

Table 1.

Distribution of thesis types according to academic degrees

Thesis type	f	%
Master	26	83,9
Doktorate	4	12,9
Proficiency in Arts	1	3,2
Total	31	100,0

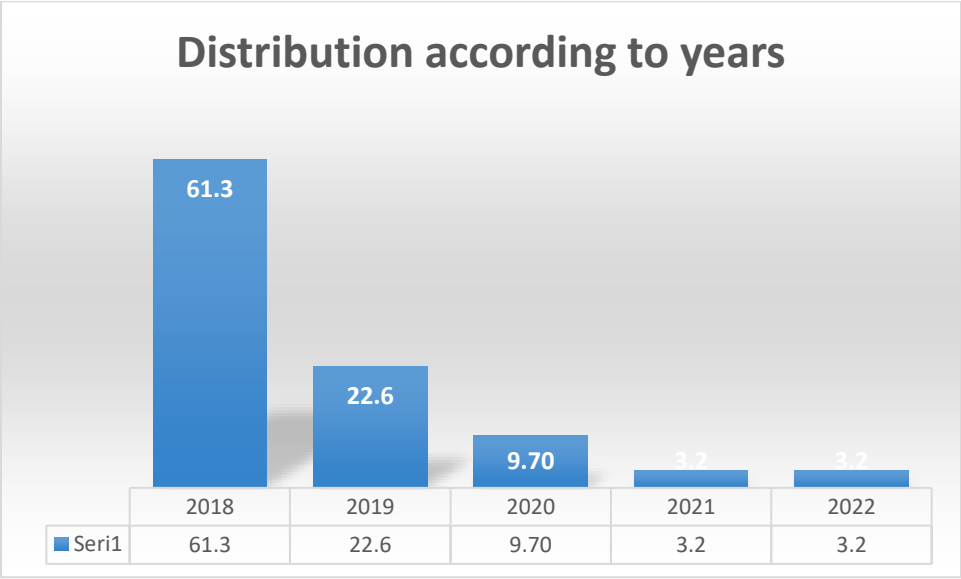
As can be seen in Table 2, when the distribution of postgraduate theses written in the field of music technologies is examined according to academic degrees, 83.9% are master's theses, 12.9% are doctoral theses, and 3.2% are proficiency in art.

3.2. Findings Regarding the Second Sub-Problem

The distribution of theses according to years is given Figure 1.

Figure 1.

Distribution of graduate theses by years



According to the data obtained from Figure 1, when the distribution of postgraduate theses written in the field of music technologies is examined by years, it is seen that the studies conducted have decreased in recent years. This decrease is thought to be due to reasons such as Covid-19.

3.3. Findings Regarding the Third Sub-Problem

The distribution of theses by language is given in Table 2.

Table 2.

Distribution by Languages Written

Language	Thesis Type							
	Master		Doctorate		Proficiency in Arts		Total	
	n	%	n	%	n	%	n	%
Turkish	23	88,5	4	100,0	1	100,0	28	90,3
English	3	11,5	0	0,0	0	0,0	3	9,7
Total	26	100,0	4	100,0	1	100,0	31	100,0

Table 2 shows the distribution of postgraduate theses written in the field of music technologies according to the languages in which they are written. According to the data, it was found out that 28 of the 31 theses were in Turkish and three were written in English. In addition, in the light of the findings, it was concluded that a foreign language other than English was not preferred.

3.4. Findings Related to the Fourth Sub-Problem

The distribution of theses by institutes is given in Table 3.

Table 3.

Distribution by Institutes

Institute	Master		Doctorate		Proficiency in Arts		Total	
	n	%	n	%	n	%	n	%
Social Sciences	11	42,3	1	25,0	1	100,0	13	41,9
Natural and Applied Sciences	4	15,4	0	0,0	0	0,0	4	12,9
Educational Sciences	10	38,5	3	75,0	0	0,0	13	41,9
Informatics	0	0,0	0	0,0	0	0,0	0	0,0
Fine Arts	0	0,0	0	0,0	0	0,0	0	0,0
Postgraduate Education	1	3,8	0	0,0	0	0,0	1	3,2
Total	26	100,0	4	100,0	1	100,0	31	100,0

According to the data obtained from Table 3, when the distribution of postgraduate theses written in the field of music technologies according to institutes is examined; It is possible to conclude that 41.9% of postgraduate

studies are carried out in social sciences and educational sciences institutes. This is followed by science institutes with a total of 12%. The distributions according to the institutes show that the studies on music technology have an interdisciplinary and multidimensional structure.

3.5. Findings Related to the Fifth Sub-Problem

The distribution of theses according to universities is given in Table 4.

Table 4.

Distribution of Theses by Universities

University	Master		Doctorate		Proficiency in Arts		Total	
	n	%	n	%	n	%	n	%
Akdeniz	1	3,8	0	0,0	0	0,0	1	3,2
Atatürk	1	3,8	0	0,0	0	0,0	1	3,2
Bahçeşehir	3	11,5	0	0,0	0	0,0	3	9,7
Bursa Uludağ	2	7,7	0	0,0	0	0,0	2	6,5
Gazi	0	0,0	2	50,0	0	0,0	2	6,5
Haliç	3	11,5	0	0,0	0	0,0	3	9,7
İnönü	2	7,7	1	25,0	0	0,0	3	9,7
İstanbul Bilgi	1	3,8	0	0,0	0	0,0	1	3,2
İstanbul Teknik	2	7,7	0	0,0	0	0,0	2	6,5
Kırıkkale	1	3,8	0	0,0	0	0,0	1	3,2
Kocaeli	1	3,8	0	0,0	0	0,0	1	3,2
Maltepe	1	3,8	0	0,0	0	0,0	1	3,2
Marmara	0	0,0	1	25,0	0	0,0	1	3,2
Mimar Sinan	1	3,8	0	0,0	0	0,0	1	3,2
Necmettin Erbakan	1	3,8	0	0,0	0	0,0	1	3,2
Ondokuz Mayıs	2	7,7	0	0,0	0	0,0	2	6,5
Sivas Cumhuriyet	2	7,7	0	0,0	1	100,0	3	9,7
TOBB	0	0,0	0	0,0	0	0,0	0	0,0
Trakya	1	3,8	0	0,0	0	0,0	1	3,2
Van Yüzüncü Yıl	1	3,8	0	0,0	0	0,0	1	3,2
Total	26	100,0	4	100,0	1	100,0	31	100,0

According to the data obtained from Table 4, in the distribution of postgraduate theses written in the field of music technologies according to universities, Bahçeşehir University 3 master's theses 9.7%, Haliç University 3 master's theses, İnönü University 2 M.Sc. and 1 PhD thesis and Sivas Cumhuriyet University. It shares the first 4 places with 2 M.Sc. and 1 Proficiency in Art thesis.

3.6. Findings Regarding the Sixth Sub-Problem

The distribution of theses according to subject is given in Table 5.

Table 5.

Table of distribution of thesis types by subject

Subject	Master		Doctorate		Proficiency in Arts		Total	
	n	%	n	%	n	%	n	%
Acoustic	2	7,7	0	0,0	0	0,0	2	6,5
Digital Music	3	11,5	0	0,0	0	0,0	3	9,7
Music Education and Technology	12	46,2	3	75,0	0	0,0	15	48,4
Music İndustry	5	19,2	0	0,0	0	0,0	5	16,1
Music Software	2	7,7	0	0,0	0	0,0	2	6,5
Sound Recording and Music Production	2	7,7	1	25,0	0	0,0	3	9,7
Turkish Music Analysis	0	0,0	0	0,0	1	100,0	1	3,2
Total	26	100,0	4	100,0	1	100,0	31	100,0

As seen in Table 5, most of the postgraduate thesis have been conducted about music education and technology (46,2%). After that, 19,2 of the examined theses are about music industry. Acoustic, music software, sound recordings and music production and Turkish music analysis have been also investigated in the theses.

4. Discussion and Conclusion

In this research, postgraduate theses written in the field of music technology in Turkey were evaluated within the framework of academic degree, year, language, institute and university criteria. In this context, master's, doctoral and artistic proficiency studies conducted between 2018-2022 were evaluated.

According to the data obtained; The most (83.9%) master's thesis was written in the field of music technology and 12.9% of them were doctoral theses and 3.2% of them were proficiency in art. For the second sub-problem, when the distribution of graduate theses made between 2018 and 2022 in the field of music technology is examined, it is seen that there is a decrease after 2018. The number of theses made in the last 5 years is 31, and it is seen that 61.3% of all theses that are the subject of the research were written in 2018. In the study conducted by Delikara (2019), when the distribution of graduate theses made between 1996-2018 was examined, it was determined that there was a significant increase in thesis studies on music technology in the last five-year period covering the years 2014-2018. In fact, it was stated that the data in this time period constituted 55.96% of all data. In our research from 2018 to the present, a significant decrease in this number is remarkable, and it is thought that there may be an effect of COVID-19.

When the distribution of the theses according to the languages in which they were written was examined, it was concluded that 90.3% were written in Turkish. Only English was preferred as a foreign language. The vast

majority of resources on music technology in the world are in English. It can be said as a positive result that the theses on the field in our country are in the mother tongue. In this context, it is not surprising that a similar result was found in the study conducted by Delikara (2019).

When the distribution rates of the postgraduate theses written in the field of music technologies are examined according to the institutes, it is observed that the theses are produced in the institutes of social sciences (41.9%), sciences (12.9%) and educational sciences (41.9%), respectively. In the study conducted by Delikara (2019), when the distribution rates of graduate theses written in the field of music technologies were examined according to institutes, it was observed that theses were produced in social sciences (46%), science (22%) and educational sciences (21%) institutes, respectively. In our research covering the year 2018-2022, the increase in theses made in the institutes of science and educational sciences is remarkable.

In the light of the data obtained, it has been concluded that the theses related to the field are predominantly made in universities where music technologies department and departments are located. In the distribution of written postgraduate theses according to universities, Bahçeşehir University shares the top 4 places with 3 master's theses, Haliç University 3 master's theses, İnönü University 2 M.Sc. and 1 PhD thesis, and Sivas Cumhuriyet University with 2 M.Sc. and 1 Proficiency in Art thesis. When the study of Delikara, which covers the years 1996-2018, was examined, it was observed that the state and foundation universities in Istanbul have taken the lead since then.

While the subjects of "Music education and technology" are mostly covered in the field of M.Sc., publications on the subject of "music industry" are mostly seen. From past to present, rapid developments in the field of technology have diversified the use of technology in music in interdisciplinary matters. When we look at Delikara's work again, it was concluded that parallel to the technological developments, studies on the field have turned towards examining the software features rather than examining the hardware features of music technologies.

Ethical Statement and Conflict of Interest

Scientific ethical principles and rules were taken as basis in all stages of this research, including preparation, data collection and analysis, and reporting. The ethical standards and conditions of the Committee on Publication Ethics (COPE) have been accepted and acted accordingly. The study did not receive funding from an institution or organization. There is no conflict of interest in the article.

Author Contributions

The authors took part in all phases of the study and contributed equally.

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*Note: Studies examined within the scope of this research are indicated with * in the references.*

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Appendix -1

Year	Thesis	Thesis Type
2018	Acoustic arrangement with do it your self (dıy) materials in home studios	Master
2018	The comparison of the acoustic modelling which was gotten by convolution method and real space reflection	Master
2018	Analysis and comparison of sound output quality difference between digital audio workstation software	Master
2018	Research on impacts of the computer- assisted piano learning on the student performance (home concert xtreme example)	Doctorate
2018	Online marketing of Turkish art music and its status within Turkish music business	Master
2018	Reflections of copyrights issues in Turkish musical environment on digital music	Master
2018	Multi vocalisatıon analysis of the songs ın secondary school music text books with digital softwares	Master
2018	A virtual audio library design for turkish music rhythm patterns	Doctorate
2018	Dimension concept and size effecting factors in the mix stage	Master
2018	The effects of music and tempo on consumer's time perception in online shopping	Master
2018	A subjective listening test on the preference of two different stereo microphone arrays on headphones and speakers listening setups	Master
2018	Sound morphing using auditory p300 based attentional brain-computer musical interface	Master
2018	The use of music in video games: The legend of zelda	Master
2018	Applicability of web based distance learning in instrumental (guitar) training	Doctorate
2018	Transformation of musician ıdentity in Turkey the context of internet and music	Master
2018	Creating digital sound effects in software	Master
2018	The effect of music technology applications on succes in musical hearing reading and writing teaching	Master
2018	The effect of music technology applications on succes in musical hearing reading and writing teaching	Master
2018	Test of the effect of technological tool and computer assisted classical guitar training method in amateur music education institutions	Master
2019	The effect of using technology-assisted teaching materials in primary education 7th-grade music teaching on academic achievements of the students	Master
2019	A curriculum proposal for the usability of the music technologies in the beginner level group piano education: mıdı piano laboratory implemantations	Master
2019	A research on the usability of accessible and assistive music technologies (example of people with disability)	Doctorate
2019	Teaching sound recording and music technologies in higher education institutions	Master
2019	Spectral variables in technical ear training: an innovative application proposal to improve the professional hearing skills of students studying in music technology education	Master
2019	The teacher's views on the use of technology in 5th grade music lessons in state and private schools	Master
2019	Computer aided comparison of classical turkish music works componented with simple makams in arel theory and theoretical information about these makams	Art
2020	Pre-school teachers and teacher candidates' attitudes towards using technology in music education	Master
2020	The effects of virtual auditary place developed as part of musical technology to intanotion awareness of string instrument learners	Master
2020	Music in digital technology era: postmodern transformation analysis	Master
2021	A research on the use of music technologies in music education departments; The case of Van province	Master
2022	The music usage status of the teachers of the lessons taken about music technology in the covid-19 period	Master

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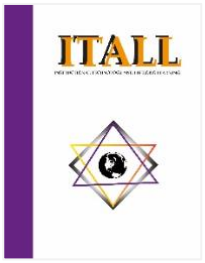

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Research Article

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Children's Literature and Ethics of Understanding

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ABSTRACT

The ethics of understanding is a set of values based on the individual's natural curiosity to seek and find the meanings that make life and human beings valuable, to take the ethical responsibility required by the answers they find, and not to seek any interest in these stages. Supporting this set of values starting from early childhood makes significant contributions to the child's affective, social and moral development. In particular, quality texts that comply with the basic principles that children's literature should bear will positively affect the development of the ethics of understanding in children. The aim of this study is to explain the relationship between children's literature and the ethics of understanding and to explain the qualities that children's books should have in terms of the ethics of understanding in line with the views of the literature. This study was conducted with a qualitative research method. The data source of the study is five children's books for preschool children. The data were collected by document analysis method and analyzed by descriptive analysis method. At the end of the study, it was seen that qualified children's books have the potential to support the ethics of understanding. The characteristics that books that support the ethics of understanding should have been determined and suggestions were presented to the authors of children's literature.

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Çocuk Edebiyatı ve Anlayış Etiği?

MAKALE BİLGİ

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ÖZET

Anlayış etiği, bireyin doğal merak güdüsünden güç alarak yaşamı ve insanı değerli kılan anlamları arayıp bulmasına, bulduğu cevapların gerektirdiği etik sorumluluğu almasına ve bu aşamalarda hiçbir çıkar gözetmemesine dayanan değerler bütünüdür. Bu değerler bütününün erken çocukluk döneminden başlayarak desteklenmesi, çocuğun duyuşsal, toplumsal ve moral bakımdan gelişmesine önemli katkılar sunar. Özellikle çocuk edebiyatının taşıması gereken temel ilkelere uyan nitelikli metinlerin çocukta anlayış etiğinin gelişmesini olumlu yönde etkileyeceği açıktır. Bu çalışmanın amacı çocuk edebiyatı ile anlayış etiği arasındaki ilişkiyi açıklamak ve çocuk kitaplarının anlayış etiği açısından taşıması gereken nitelikleri alanyazın görüşleri doğrultusunda açıklamaktır. Nitel araştırma yönteminin kullanıldığı çalışmanın veri kaynağı okulöncesi döneme seslenen beş çocuk kitabıdır. Veriler doküman inceleme yöntemiyle toplanmış ve betimsel çözümleme yöntemiyle çözümlenmiştir. Çalışmanın sonunda nitelikli çocuk kitaplarının anlayış etiğini destekleyecek bir potansiyele sahip olduğu görülmüştür. Anlayış etiğini destekleyecek kitapların taşıması gereken özellikler belirlenerek çocuk edebiyatı yazarlarına öneriler sunulmuştur.

1. Introduction

In today's world, changing technology has increased the possibilities of interpersonal, international and intercultural communication. Web technologies, cloud computing and augmented reality have played an important role in this progress and diversified communication channels. Despite these developments, there has not been the expected improvement in human understanding of human beings; on the contrary, incomprehension has continued to be widespread. In this regard, Morin (1999: 49) states: Of course, we have witnessed tremendous progress in understanding each other. But incomprehension seems to progress even faster. As a matter of fact, no communication technique has the power to realize human understanding by itself. Only when these techniques meet with a qualified education and when interpersonal understanding is at the center of this education, the ethical solidarity of humanity will be able to show the desired development.

Despite the increasing diversity of communication, paradoxically, the decline in empathic skills, altruistic behavior and ethical questioning in today's individualized world demonstrates that there is indeed a problem of understanding. Indeed, increasing social distance, both on an individual and societal scale, deepens the gulf of incomprehension between conflict sides, whether distant or close. Violence, jealousy and fear, incompatible with a culture of human rights and democracy, prevail on our planet. It is therefore crucial to remember and develop the possibilities to reverse this situation. This value is becoming increasingly important in educational processes. The ethic of understanding is closely related to the concepts of empathy, sensitivity and assertiveness in general.

Books that do not have literary qualities are problematic in terms of ethics of understanding. Gürdal-Ünal (2015) gives the following example: In Hüseyin Ergül's story Sakat Çocuk (Crippled Child), there is a child on crutches who is saved from the beatings of bullies in the schoolyard. This boy leaves the schoolyard on crutches without saying anything. We know nothing about this character except that his name is İhsan. The narrator asks "What does this boy feel when he hits? Is he sick, sadistic, enjoying it? Let's say this one is like that. What about the others? Why don't they stop him? Why don't they react to injustice, to the powerlessness of a beaten child?"

This situation can be explained by open/developed character and closed/undeveloped character in children's literature. The open/developed character is a deep and multidimensional character who is introduced with many features, whereas the closed/undeveloped character is a shallow and one-dimensional type who is introduced superficially. In this regard, Sever (2012: 105) states that the author can make use of closed/undeveloped characters in order to draw attention to the protagonist with whom the child will identify and explains as follows:

For example, a selfish and lazy antagonist can be used to emphasize the sharing and hardworking characteristic of the protagonist. The main purpose here is to give children the opportunity to compare the developed and undeveloped person. This view is problematic in terms of the ethics of understanding because in the example given, it is not explained why the undeveloped person is selfish and does not like to work. A child confronted with this example will not know the underlying reasons for selfishness and laziness. However, the ethics of understanding should illuminate the shadowy areas such as this example. As it is, it cannot explain the questions "Why should I be sharing? Should I be hardworking?". To summarize, if children's literature wants to develop children intellectually, it must have the transparency required by the ethics of understanding.

Another controversial issue in the literature is whether the cast of characters in books written for children should be familiar or not. Aytekin (2016: 52) argues that the people in children's books should not be chosen from among people the child does not know or recognize. In other words, he argues that these people should be familiar. When this claim is viewed from the perspective of identification, this choice may be appropriate because it may be easier for the child to identify with people, he/she knows than with people he/she does not know. However, from the perspective of the ethics of understanding, the situation is the opposite. Because the child who encounters only the people, he/she knows in the books he/she reads will never meet the other. In this case, the child will never understand people other than those presented to him/her by society. Moreover, he/she will not even be aware of the existence of people other than these. In short, the people in children's books should be distributed in a balanced way, just like in real life, in terms of whether they are familiar or not. A fiction in which the child can recognize and understand different people should be created.

The man's search for meaning is the basic motivation of life. This meaning is unique and special to the individual; therefore, it can only be fulfilled by oneself. Thus, the person can satisfy his or her own desire for meaning (Frankl, 2021: 105). For this reason, there should be a content that supports the child's search for meaning. Children's books should not be authoritarian and should leave the responsibility of feeling and thinking to the reader. Frankl (2021: 11) says the following on this subject: To live is to suffer, and to survive means to find meaning in suffering. If life has meaning, suffering and death have meaning, but no one tells anyone else what that meaning is. Everyone has to find this meaning for themselves and accept the responsibility that this answer entails. The person who manages to do this continues to grow in spite of all humiliating situations.

1.1. Two Types of Understanding

Educational processes enable the transfer of knowledge and the realization of learning through communication, but if knowledge is not well communicated or understood, the stage of human intersubjective understanding is not reached. In other words, the act of understanding does not go beyond the act of knowing at the mental level, and as such, it only provides the precondition. The ultimate goal should be human understanding, which involves the subject-to-subject knowledge. For this reason, educational processes should be structured to support human understanding in all areas from goals to content, from educational situations to evaluation processes. Although all subject courses have a responsibility in supporting human understanding, language and literature courses have the greatest responsibility. This is because communication skills and literary forms of communication are at the center of language and literature courses.

Language and literature courses are framed by Turkish Language in primary education and Turkish Language and Literature in secondary education. The curriculum of these courses is also important in terms of defining the prerequisite for the ethics of understanding. For example, the Turkish Language Teaching Program (MEB, 2019) aims to develop students' listening/watching, speaking, reading and writing skills and to create a love and habit of reading and writing in them. Similarly, the Turkish Language and Literature Curriculum (MEB, 2018) supports students to use listening, reading, writing and speaking strategies correctly and appropriately. In short, language and literature courses form the basis for the ethics of understanding in terms of curricula.

The tools used in language and literature teaching are crucial in achieving the aforementioned goals. The most important tool of language and literature education is quality literary texts. Although the texts used in these courses vary, literary texts will make the greatest contribution to the ethics of understanding. Literary texts are fictional texts written in a genre such as poetry, short stories, novels, etc. and have the potential to develop the reader's feeling/thinking skills. As Sever (2012) states, Literature offers us a life constructed with an artist's sensibility. It adds new meanings to our lives and enriches our experiences. It makes us partners in the experiences of others.

Reading is an action that does not separate us from other people, on the contrary, it brings us into much deeper relationships with people. It can reveal a deeper understanding that we can never achieve in daily life (Güven, 2020: 20). Literary quality children's books present a wide variety of life situations to their readers. Even a single children's book shows how different other people are in terms of their mental characteristics, social status and

character traits. As Göktürk (2010: 22) states, the author modifies the natural language in order to convey the human condition he wants to express.

The feature that makes life meaningful in children's literature is the aesthetic relationship. According to Erinç (2011: 25), aesthetic relationship is the experience of creating and developing certain designs through objective beings; but at the basis of these designs lies aesthetic appreciation, or in other words, beauty. Accordingly, for a children's book to be admirable in terms of its internal and external structure, it must be beautifully constructed.

The child who participates in this relationship as a reader becomes a part of the aesthetic relationship and the book creates aesthetic experiences in him/her. Fictional reality in children's books can enable children to gain experiences that make life meaningful, to identify with fictional characters, and to understand themselves and others by developing empathy skills. In short, with quality books, children both become a part of this aesthetic world and take an active role in the process of understanding. On the other hand, poor quality books do not contribute to children's understanding skills, nor do they contribute to their aesthetic development. These books are designed only to give advice, convey a message and condition the reader; they have a dull, boring, unbelievable and uncreative narrative.

1.2. Teaching Obstacles to Understanding

As Morin (1999: 50) points out, the exterior obstacles to comprehension are numerous. Understanding the meaning of the another's words, his ideas, his world view, is always, everywhere, endangered by a variety of factors. These factors can be classified as *noise*, *polysemy*, *cultural blindness*, *egocentrism*, *ethno-sociocentrism* and *reductive mind*.

Noise is defined as any phenomenon that disturbs the transmission of a message, in communication theory, (TÜBA, 2013). Accordingly, anything that causes communication disruption due to various reasons such as incorrect coding and incorrect decoding of the message can be called noise. In this regard, Elgünler and Fener (2011: 36) stated that noise elements such as prejudiced attitudes, stereotyped beliefs, value judgments, and differences of opinion prevent communication.

Noise in children's literature may originate from the author, the publishing house or the reader himself/herself. People and institutions with different responsibilities in this regard should make critical evaluations. For example, it should be questioned whether children's books are free of political, ideological and religious indoctrination (Aslan, 2014: 52), depict cultural groups without exaggeration or romanticization (Russell, 2009:

86), and present a complete profile of the cultures, contributions and experiences of ethnic groups (Gay, 2014: 156). It should also be analyzed whether stereotypes, prejudices and discrimination are present and whether they are affirmed in literary fiction (Uslu, 2019).

Polysemy is when a word, phrase or sentence has more than one meaning (TÜBA, 2013: 529). In his work Fatal Identities, Maalouf (2018: 15) writes: "My life as a writer has taught me to avoid words. The ones that seem the most obvious are often the most dangerous." This statement is used for all ideologically problematic and fundamentally irreconcilable words. Özüdoğru (2016: 144-145) gives examples of polysemous words such as democracy, freedom and justice and defines them as words that are fundamentally ideologically irreconcilable. For example, the word tolerance, which is generally attributed positive values, can conceptually mean understanding/respecting the thoughts and behaviors of others, but on the contrary, it can also mean inequality, hierarchy, asymmetry. For this reason, it is important to recognize the tolerant and tolerated sides in children's books. Otherwise, even the best intentions can lead to the reinforcement of negative messages, the reproduction of social inequalities and the legitimization of discrimination. Especially in the early years of school, when, as Sever (2012: 43) puts it, many new words are being added to children's vocabulary, the polysemy of each word in children's books should be carefully analyzed.

Cultural blindness means seeing one's own cultural characteristics as a normative value and being closed to other cultures. According to Morin (1999: 50), ignorance of the rites and customs of others, namely rites of courtesy, may lead to unknowingly insulting the other or disgracing oneself. For this reason, children's books should include not only national culture, but also international culture and social contact should be improved. At this point, translated children's books also play an important role. It is important that more translated children's books meet children’s readers and that the translations are sensitive to cultural values. In this way, children will have the opportunity to look from the perspective of other cultures and understand themselves better. In this regard, Russell (2009: 93) states that our biases generally stem from ignorance and books can be a bridge to a greater human understanding.

Egocentrism means being insensitive to the needs and interests of others, being concerned only with one's own interests and considering one's own values as valid for everyone (TÜBA, 2013). Egocentrism takes different forms at each stage of cognitive development. For example, egocentrism in the preschool period means seeing things from someone else's point of view and being incapable of recognizing the feelings/needs of others (Gander &

Gardiner, 2010: 259). However, over time, children begin to realize how others think or feel. It is precisely at this stage that quality children's books are needed to support the expected developmental task.

Ethno-sociocentrism is one of the biggest obstacles to understanding. In this regard, Morin (1999: 51) states, these centrism's feed xenophobia and racism, sometimes to the point of treating foreigners as if they weren't human beings. The fight against all for racism would be more effective if it were aimed at the ego-sociocentric roots, not the superficial symptoms. For this reason, children's books that center on their own cultural group should be questioned. Because societies aim to transfer their language and cultural codes to children, whom they see as the guarantee of their existence, through children's literature. For this reason, every society wants to give children's literature a content according to the type of child it wants to create; it wants to make directions for this purpose (Çağan, 2006: 41).

Reductive mind is the explanation of a complex phenomenon in terms of a more basic and simpler conceptual scheme. Reducing a complex knowledge has very negative consequences, both ethically and physically. According to Morin (1999: 52), it is this reductive, simplifying, dominant mode of thought, combined with mechanisms of incomprehension that reduces the naturally multiple personality to one of its features. Children's literature should be free from all kinds of reductive, simplifying and narrowing approaches. For example, characters in children's books should be portrayed as individuals with genuine feelings, thoughts and beliefs, and not as types representing a specific group (Russell, 2009: 86).

1.3. Ethics of Understanding

Morin (1999: 52) states that the ethics of understanding is a refinement that begins with disinterested understanding. This demand great effort, because there can be no hope of reciprocity: the person threatened with death by a fanatic understands why the fanatic wants to kill him and knows that the fanatic will never understand him. Understanding that the fanatic cannot understands us means understanding the roots, forms, and manifestations of fanaticism. It is understanding why and how a person feels hatred or contempt.

Since the situation that the ethics of understanding seeks to understand is incomprehension, it is necessary to closely recognize the unethical attitudes and behaviors that constitute incomprehension. These attitudes and behaviors include moral exclusion, dehumanization, abuse, creating social hierarchy, devaluing the victim, stigmatizing, marginalizing, lynching, using political labels, exorcism, delegitimizing the system and establishing social dominance. In addition, ideologies such as essentialism, sexism, ageism, racism, ethnocentrism,

sociocentrism also have unethical characteristics. The common aspect of all these attitudes and behaviors is that they constitute an obstacle to the ethics of understanding. Ethics of understanding requires the rational use of one's skills; thus, there is a need to develop cognitive and affective skills such as ethical reasoning, empathy, valuing diversity, and loving/being loved.

Ethical justification is a way of reaching valid and reliable knowledge, and reality can only be known through a rational reasoning. In children's literature, opinions and assumptions without any rational basis should not be affirmed; on the contrary, they should be problematized and criticized. However, for a real ethics of understanding, one should think about why and how people with unjustified/ungrounded opinions and assumptions reach these assumptions. In addition, for ethical justification in children's literature, books should be questioned in terms of randomness. As Sever (2012: 138) states, if the child reader is confronted with an unacceptable result that is disconnected from the emotion and thought preparation, he/she made during the act of reading, the problem of reliability between the author-book-child begins to occur.

Empathy is the ability to put oneself in the other's shoes through a temporary and voluntary identification and to understand their feelings, thoughts and behaviors (TÜBA, 2013: 427). Empathy skill in children is realized through modelling the protagonist. According to Sever (2013: 64), modeling is an important factor that nourishes children's learning and development. Children develop their own behavior examples by modelling the others around them.

Valuing diversity is an opportunity to recognize different cultural characteristics through children's literature. Books featuring characters from different cultural backgrounds help young readers to internalize multiculturalism. First reading experiences allow children to feel the emotions of diverse people. As Russell (2009) points out, one of the great benefits of children's literature is that it can broaden young minds and show children the essential humanity in all people, regardless of their color, religious beliefs, languages and traditions and show children the fundamental humanity in all people regardless of their color, religious beliefs, language, and customs.

Loving/being loved is one of the leading themes in children's literature. Love is the only way to understand a person to the very depths of their personality. No one can comprehend the depths of another person unless they love them. Through love, one gains the ability to understand the important aspects and characteristics of the loved one (Frankl, 2021: 116-117). In this regard, as Morin (1999: 52) states, understanding neither excuses nor accuses. It teaches us to refrain from condemning hastily, irremediably, as if we ourselves had never erred. İf we

learn to understand before condemning, we will be on the way to humanizing human relations. On the other hand, there are some methods that facilitate understanding: *thorough thinking* and *introspection*.

Thorough thinking is a way of thinking that can grasp text and context, individual and environment, local and global, the multidimensional, in a word, the complex: the conditions of human behavior. And this thorough thinking helps us understand the objective and subjective conditions of behavior (Morin, 1999: 53). Thinking, which is the independent and unique action of the mind, is the ability to grasp connections and forms, to make comparisons, to separate and combine (Başarer, 2021: 1). Thorough thinking gives the opportunity to understand all aspects of the conditions that constitute a behavior. An individual who has developed good thinking skills is more successful in controlling their attitudes and behaviors. Because thinking is a mental behavior used to understand facts, events and people (Başarer, 2021: 2). The main function of children's literature is that it contributes to children's conceptual development process and their ability to understand and explain; it operates cognitive processes such as labeling and associating new concepts learned (Sever, 2013: 32).

Introspection is the observation and examination of one's own feelings, thoughts, cognitive processes, perceptions, memories and motives (TÜBA, 2013). The mental practice of continuous self-examination is necessary because when we understand our own weaknesses and failings, we can understand the weaknesses and failings of others (Morin, 1999: 53). In children's books, the introspective method is seen especially in the conflict with oneself: Through internal conflict, a character's indecisions and confusions are embodied.

Understanding others demands *awareness of human complexity* (Morin, 1999: 53). Children's books offer various opportunities to understand this complexity. For example, children who break their toys in everyday life may receive similar accusatory reactions from the adults around them on the grounds that they use their belongings rudely and show violence. However, if children's books question why children break their toys in literary fiction, the social and psychological reasons underlying this behavior can be revealed.

1.4. Planetary Understanding, Ethics and Culture

Planetary understanding, ethics and culture is a global understanding that serves the human species. This understanding means that Oriental and Western cultures can come into contact with each other without losing their core values or becoming identical. For example, in fields such as science, literature, art and philosophy, it is necessary to sincerely seek to know the other culture; to take into account the historical, social and economic

conditions in which that culture exists; and to nurture and be nourished by that culture. In this way, global civilization will be able to realize itself.

Planetary understanding requires first and foremost the existence of a culture of democracy. "The culture of democracy in the sociological context means the way of life in a country governed by democracy. In its intellectual context, the culture of democracy means knowledge, thought, sensitivity, morality and artistic understanding appropriate to the democratic order" (Fuat, 2000: 56). Understanding between societies implies open democratic societies, which means that the path to understanding between cultures, peoples, and nations implies a generalization of open democratic societies (Morin, 1999: 55). In contemporary democracies there is no higher power that distributes or withdraws freedoms. Thought, speech, action and freedoms do not depend on the tolerance of a higher power. Within the framework of laws made in the name of the people, everyone uses their freedoms in the direction they want without anyone tolerating them (Fuat, 2000: 15).

One of the most important characteristics of the person that the culture of democracy wants to raise is to be developed in terms of emotion and thought. Considering that this characteristic is not sufficiently developed in today's people, it is inevitable that the culture of democracy will be replaced by a culture of violence. However, a planetary understanding requires analyzing the underlying causes of violence, such as frustration, anger and the perception of superiority. In other words, it reveals the causes of violence and can foster interpersonal and intercultural understanding. As Sever (2013: 63) states, children's emotional and intellectual health is harmed by violent, ideological and didactic books. Children are surrounded by ideologies that are manipulated, contrary to human nature, aim to destroy human sensitivity, and naturalize aggression and violence (Sever, 2013: 63). Children's books also have important roles and responsibilities in this development. Children's books should fulfill their responsibility for children to carry democratic values and develop democratic culture through the characters and messages they construct.

The culture of democracy requires the existence of individuals with autonomous identities; therefore, children's books also play a role in the development of autonomous identities. As Aslan (2016: 729) states, in order for children's books to contribute to children's autonomy, they should not contain obstacles to thinking skills. Examples of these obstacles include blind obedience to a certain authority, belief or ideology, making inferences based on limited or few evidence, making overgeneralizations and simplifications, making negative evaluations of others, defending prejudice, stereotypes and discrimination, egocentric, dogmatic conditioning, labeling.

1.5. Children's Literature and Ethics

The title "ethics in children's literature" encompasses two important concepts. One is an ethical understanding that can be called "children's literature ethics" and whose main purpose is to determine the basic principles and rules of children's literature. In this respect, children's literature ethics is a field ethics just like "bioethics", "medical ethics" and "business ethics". As Tepe (2015: 99) states, "field ethics primarily aims to develop norms related to their field of endeavor and to define them as the ethical codes of the field in question." When it comes to children's literature, the basic characteristics of children's books and the internal/external structure of children's books (Aslan, 2017; Erkmen, 2017) are concrete examples of children's literature ethics. Although the principles and features of children's literature have been frequently on the agenda in the literature in the last decade or so, the discussion of the issue in the context of "children's literature ethics" is largely new. In this regard, Sever (2013: 73) states that works of children's literature should create a common language that comprehends and reflects the sensitivities specific to children, and this common language, which draws its strength from the universal principles of literature, should contribute to the formation of children's literature ethics.

The second important concept is *ethical inquiry in children's literature*, which is an intellectual inquiry activity that takes place through children's books. Ethical questioning in children's literature is multifaceted and requires certain characteristics of the people involved in the questioning process. For example, the experience of the teacher who engages in philosophical inquiry with children's books and the student's ability to receive the children's book are decisive for ethical inquiry in children's literature. For this reason, *thorough thinking* is indispensable for ethical inquiry in children's literature, because thorough thinking is a way of thinking that enables us to perceive the text and its context, existence and its environment, the local and the global, in short, the complex as a whole.

Considering the textual dimension of children's literature, the most important requirement is that children's books have a style that is conducive to philosophical inquiry. The first example that comes to mind in this regard is the so-called philosophy books for children. However, as Erdem (2013: 138) states, although these books give great hope for the development of the field, they have not yet been subject to comprehensive scientific analysis and have problematic aspects in general. Making philosophy the subject of a text is not a sufficient condition for philosophical inquiry. Moreover, the concept of ethical questioning in children's literature is not limited to philosophy books for children. Fictional children's books and textbooks should also be matched in terms of ethical values and suitability for philosophical inquiry.

The concept of *ethical questioning in children's literature* covers a different concept area than children's literature ethics. The concept of ethics in children's literature should be understood as the questioning of ethical issues in the content of literary texts addressed to children. For example, morality, justice, obligation, responsibility, values and values are ethical issues (Tepe, 2015). In addition, questions such as "Why shouldn't I lie?", "Why should I be moral?", "What is good or bad?", "Which of my behaviors am I responsible for?" (Direk, 2006: 6) are also questions with philosophical potential. All children's books that allow philosophical reflection on these and similar issues have a potential for philosophical inquiry.

On the other hand, there are some similarities between *ethics in children's literature* and *ethical inquiry in children's literature*. In other words, both are in search of solutions to problems that are contrary to human rights, inhibit human development and violate the value of human beings. In this context, it should be emphasized that group antagonism, which consists of the components of stereotypes-prejudice-discrimination, is an important ethical problem. This importance stems from the ethical responsibility of children's literature. Therefore, both "ethics of children's literature" and "ethical inquiry in children's literature" should jointly seek solutions to the problem of group antagonism. It should be an integral part of this responsibility that children's literature, both as a field of scientific study and as a literary product, should be able to criticize itself, find and discuss the unethical aspects within it.

The development of children's literature ethics requires the cooperation of authors, illustrators, publishers, teachers, parents and children. This cooperation should aim to produce a children's book in which ethical inquiry can be made and to develop critical and universal literacy skills. For this purpose, the literary fiction of children's literature should be constructed in a way that supports children's skills such as empathy, love, respect, nonviolence, cooperation, conflict resolution and reflection. The messages in children's books should suggest ways to cope with group antagonisms. It should be taken into consideration that books that are fictionalized with the influence of the cultural characteristics of past years, but do not have a literary quality and are far from today's children's reality, may cause emotional damage to children. The character fiction of children's books should also be structured with democratic attitudes and behaviors. The cast of characters should consist of characters of various genders, races, ages, religions, classes and physical appearances, and these characters should be portrayed with their dynamism and diversity. The traditional approach, which affirms static, uniform, normative characters and marginalizes others, should be replaced by a contemporary modern approach. In children's books that can contribute to the development of democratic culture, the protagonist should have certain characteristics:

internalizing democratic culture, complying with the requirements of modern life, being balanced in terms of personality structure are some of them.

If the aim of language and literature teaching is to raise thinking and sensitive individuals, and if this aim is to be realized through children's literature, both language and literature teaching and children's literature are expected to include ethical issues. According to Nikolajeva (2012: 1-4), children's literature has an important potential that enables the questioning of ethical issues. Children who have not yet developed a full cognitive comprehension can take cognitive and affective responsibility and increase their life experiences through literature. n this regard, as Sever (2013: 75) states, "The basic condition for the formation of children's literature ethics is that children's literature can respond to the interests and needs of the child. If children put into practice the rules they are forced to follow or the ideas they are asked to adopt without understanding them sufficiently and without testing their importance in human and social life, they may be distanced from their own reality.

Children's books that do not take into account the ethics of children's literature may cause some emotional damage to the child. For example, as Sever (2013: 81) states, if adults direct children according to their truths, they can turn them into passive people unaware of their rights by distancing them from their own truths. As Aslan (2017: 11) states, if societies cannot raise children with a developed sense of autonomous self, children may make biased, guided, rote and uninformed. Based on these views, it can be argued that it is necessary for authors, illustrators, teachers and researchers to question children's literature books from an ethical perspective. Works of children's literature should create a common language that comprehends and reflects child-specific sensibilities, and this common language, which draws its strength from the universal principles of literature, should contribute to the formation of children's literature ethics (Sever, 2013: 73).

The aim of this study is to explain the relationship between children's literature and the ethics of understanding and to explain the qualities that children's books should have in terms of the ethics of understanding in line with the views of the literature. For this purpose, the following question was analyzed: Are children's books addressed to preschool children capable of developing an ethics of understanding?

2. Method

This study, which aims to analyze children's books in terms of ethics of understanding, is qualitative research. As Miles and Huberman (2016) state, qualitative research looks at a field or social section from a holistic perspective, uses qualitative data collection tools, and performs most of the analysis with words and clusters of words. The

object of the study consists of children's books addressed to the preschool period. The study was formed through "criterion sampling", one of the purposeful sampling methods. The criteria are as follows: (1) to be written in accordance with the age and developmental characteristics of preschool children, (2) to be written in Turkish or translated into Turkish, (3) to be published in 2010s, (4) to be written in story genre, (5) to have a literary quality. Information about the books in the study group is shown in Table 1.

Table 1.

Study group

	Book Title	Author	Illustrator	Publisher
1.	Farklı ama Aynı	Feridun Oral	Feridun Oral	Yapı Kredi Publishing
2.	Oyuncaklarını Kıran Çocuk	Canan Aslan	Ferit Avcı	Kök Publishing
3.	Pezzettino	Leo Lionni	Leo Lionni	Elma Publishing House
4.	Sophie Poni: Tekboynuz Uzmanı	Morag Hood	Ella Okstad	Pearson Publishing
5.	Nokta	Peter H. Reynolds	Peter H. Reynolds	Altın Publishing

Document analysis was used as a data collection tool in the study. Document analysis examines the materials containing information about the subject of the research. In this study, the written texts of the books in the study group were analyzed. This analysis aimed to conceptualize and theorize the ethics of understanding in children's books. Descriptive analysis method was used in the presentation of qualitative data. As noted by Coşkun (2019: 178), descriptive analysis used in qualitative research method involves summarizing and interpreting the data according to the themes revealed by the research questions. Ethics committee approval was not required as this was not a human study.

3. Result

3.1. Results for The Book "Farklı ama Aynı"

Oral (2015) tells the story of a newborn goat with disabilities in his book. At the beginning of the story, he says *This was a very cute kid with black ears. But she was born a little different from the other babies in the herd. The shepherd immediately noticed the weakness in his legs*. At first the goat has difficulty keeping up with the herd and the shepherd carries it in his saddlebag. As the goat grows older, it becomes difficult to carry it in the saddlebag, so the shepherd builds a wheeled carriage for it. So, the goat can roam freely in the fields. One day she also has two kids. One is black and one is white. They are different from their mother but the same.

In this story, the phenomenon of disability is not dealt with in a reductive manner. There are no stereotypes, prejudices and discriminatory behaviors against the disabled from a sociocentric perspective. There is no

exaggeration or romanticization in emotions. On the contrary, the goat's emotions, dreams and what it likes to do are described in detail. The feelings and thoughts of the shepherd are also clear. His empathy with the goat, carrying it in his saddlebag, making a wheeled cart for it and rejoicing when he sees it running in the fields are altruistic behaviors. The relationship between the goat and the shepherd is based on understanding. A child reading this book knows why the goat and the shepherd think and behave the way they do. This is because people are in the foreground with their character traits, not their typical characteristics. In short, this book is designed to support the ethics of understanding.

3.2. Results for The Book "Oyuncaklarını Kıran Çocuk"

Aslan (2011) tells the story of a boy who breaks his toys. Taylan, the protagonist of this story, breaks and destroys his toys and even tears them to pieces. Taylan's toys couldn't stand it and one day they decided to talk to him. In reality, Taylan was taking the toys apart because he was curious about how they worked. In this story, why the protagonist broke his toys, how he felt when they were broken into pieces, whether he felt regret, and what he thought about his broken toys were explored in detail. He is not blamed, judged or punished for breaking his toys. He was not advised to break his toys again and was not threatened or intimidated.

The fact that the broken toys in the story communicate with the protagonist, ask him why he broke his toys, and listen attentively to the answer shows that there is open communication. This open communication is important for understanding the others' feelings, thoughts and behaviors along with their reasons. A child who reads the story can have empathy with the protagonist and the toys. It can be seen that a behavior that is seen as an act of violence at first glance is actually caused by the child's sense of curiosity. Of course, the book does not advise the child on violence, but it provides an opportunity for the child to question the situations that constitute the act of violence.

3.3. Results for The Book "Pezzettino"

Lionni (2012) tells the story of Pezzettino, who thinks he is a small part of a whole and searches for the whole. . At the beginning of the story, he says *His name was Pezzettino. All the others were big and did daring and wonderful things. He was small and surely must be a little piece of somebady else, he thought. He ofen wondered whose little piece he could be, and one day he decided to find out.* In the story, Pezzettino asks different people who he is part of, but gets no answer. The answer comes when he goes on a long journey and has an individual experience: "I am myself!" he shouted full of joy. His friends didn't quite understand what he meant, but Pezzettino seemed happy, and so they were happy too.

All the characters in this story are different and unique. The other characters are not indifferent to Pezzettino, on the contrary, they share his adventure. Differences and diversity are valued. There is an effort to understand life, but the answers to questions about life are not given by an authority. Pezzettiono searched and found it himself. In terms of the ethics of understanding, the introspective method is used. A child who reads this story may be willing to respect differences, get to understand them closely, recognize the reasons for their behavior, and move away from egocentrism.

3.4. Results for The Book "Sophie Poni: Tekboynuz Uzmanı"

Hood (2018) tells the story of what a unicorn expert girl does in one day: *I have so many unicorns at home ... If I remember correctly, I have 17 unicorns. Taking care of so many unicorns, taking care of each and every one of them, is no easy task. Lucky, I am a unicorn expert.* In this story, the protagonist Sophie thinks about the needs and interests of her unicorns, feeds them, protects them, entertains them. She teaches them lessons and reads book. These are altruistic acts and Sophie does them every day without expecting anything in return. The story is humorous and ironic. Therefore, egocentric thoughts and behaviors are criticized in an enjoyable way.

In this story there are unicorns of different shapes, colors and types, showing that diversity is valued. A child who reads this story understands that there can be differences in feelings, thoughts and behaviors and that these should be tolerated. He/she can also easily interpret the reasons behind the protagonist's behavior and thoughts. He/she can put himself/herself in the protagonist's shoes and identify with him/her.

3.5. Results for The Book "Nokta"

Reynolds (2014) tells the story of an unhappy child who has never been able to draw in art class and discovers his own talents. The art teacher asks Vashti to make at least one dot. The following week a picture in a decorated frame hangs on the wall in the classroom: Vashti's dot! From that day on, Vashti keeps making different dots. A few weeks later, Vashti's drawings are displayed at the school exhibition. In this story there is a protagonist who analyzes his own feelings and abilities through introspection. He realizes his inadequacies, works to unlock his hidden potential, overcomes difficulties and finally encourages another friend.

In the story, the art teacher's recognition of Vashti's unhappiness is important for the ethics of understanding because it is an empathic act. She recognizes Vashti's nervousness and makes a joke to soften her. this corresponds to the degree of intersubjective human understanding. A child reading this story might identify with Vashti and reflect on her own inadequacies. If he/she is hesitant to reveal his/her hidden strengths, he/she can focus on the

reasons for this. He or she can also encourage others around him or her to look inside themselves and avoid egocentrism.

The children's books analyzed in this study have some similarities and differences. The most important similarity is that subject-to-subject knowledge, which forms the basis of the ethics of understanding, is supported through fictionalized characters. In other words, the protagonists in the stories are of a quality that child readers can identify with. This supports children to develop empathic skills. Another similarity is the disapproval of reductive ideas such as egocentrism and ethno-socio-centrism. In this way, the child reader can internalize tolerance and develop an ethic of planetary understanding. The last similarity is the opposition to reductive ways of thinking. In other words, these books are appropriate tools for exploring the complexity of human beings. On the other hand, these books differ from each other in terms of the themes they address. These books focus on sensitivity towards people with disabilities (Oral, 2015), abilities and competencies (Reynolds, 2014), belonging and autonomy (Lionni, 2012), responsibilities (Hood, 2018) and personal interest (Aslan, 2011).

4. Discussion and Conclusion

Children's literature plays an important role in the cognitive and affective development of children. One of these roles is to contribute to the ethics of understanding in children. A children's book that responds to the child's age and developmental characteristics, interests and desires enables the child to understand himself/herself and his/her environment without judgment. It enables them to get rid of egocentric thinking and think empathetically, to identify with people and to understand the reasons underlying their thoughts and behaviors. The findings obtained in the study are parallel to the views in the literature. As Aslan (2017) states, contemporary children's literature should include sensitive issues and address these issues from an ethical perspective. Similarly, Erdem (2013: 24) considers it important to provide thinking education based on works of literature that children can read. Sever (2012: 23) also stated that in children's books, the author supports the child to think and understand by giving some fictional clues.

Developing an ethic of understanding through children's literature is a key concept in lifelong learning. Because reading activities carried out independently of time and space can contribute to the individual's understanding of all kinds of marginalizing behaviors and to recognize social problems and produce solutions. The individual's ability to continue his/her life in harmony with the society depends primarily on the acquisition of empathic skills

and the maintenance of these skills throughout life. Thus, reading culture is the basic condition for lifelong learning.

The following suggestions can be offered for children's books that support the ethics of understanding. Characters in children's books should not only include the usual characters, but on the contrary, they should value diversity by including differences in gender, sexual orientation, ethnicity, religion, age, physical appearance, disability, etc. Children's books should not have an authoritarian approach. Children should reach conclusions by making their own logical inferences. Children's books should not blindly follow an ideology or make inferences based on limited or few evidence.

Ethical Declaration

In this study, all scientific ethical rules were followed.

Conflict Interest and Author Contributions

All stages of study were organized and conducted by Author. There is no conflict to interest.

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STEM and Early Algebra: Reflections from Primary School Teachers' Practices

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ABSTRACT

This study aims to determine the opinions of primary teachers about the implementation of STEM-based practices in early algebra teaching. The phenomenology design, one of the qualitative research method designs, was used. The study group of the research was determined using the criterion sampling technique, one of the purposive sampling techniques. The study group consists of 5 primary teachers who have received STEM education and have implemented STEM-based applications in early algebra teaching. A semi-structured interview form was used to collect the data. The qualitative data obtained at the end of the research were described with the content analysis method. In light of the findings, most teachers noted that STEM-based applications in early algebra teaching could be given from the first grade of primary school. The teachers, who indicated that STEM-based activities are applicable in early algebra teaching, stated that these applications would have advantages such as gaining a positive attitude towards the mathematics lesson, providing fun learning environments, facilitating learning, and embodying abstract subjects. In addition, teachers commented that they experienced difficulties such as a lack of materials, crowded classrooms, dense curriculum, and insufficient technological infrastructure. Teachers suggest that teachers and administrators who carry out STEM-based practices in early algebra teaching should conduct research, take STEM education, and apply it in their classrooms.

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STEM ve Erken Cebir: Sınıf Öğretmenlerinin Uygulamalarından Yansımalar

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ÖZET

Bu çalışmanın amacı, erken cebir öğretiminde STEM temelli uygulamaların yürütülmesine ilişkin sınıf öğretmenlerinin görüşlerini belirlemektir. Araştırmada, nitel araştırma yöntemi desenlerinden olan fenomenoloji deseni kullanılmıştır. Araştırmanın çalışma grubu, amaçlı örnekleme tekniklerinden biri olan ölçüt örnekleme tekniği kullanılarak belirlenmiştir. Çalışma grubunu, STEM eğitimi almış ve erken cebir öğretiminde STEM temelli uygulamaları gerçekleştirmiş 5 sınıf öğretmeni oluşturmaktadır. Araştırmanın verilerinin toplanmasında yarı yapılandırılmış görüşme formu kullanılmıştır. Araştırma sonunda elde verilen nitel veriler, içerik analizi yöntemi ile betimlenmiştir. Elde edilen bulgular ışığında öğretmenlerinin çoğunluğu, erken cebir öğretiminde STEM temelli uygulamaların ilkokul 1. sınıftan itibaren verilebileceğini ifade etmiştir. STEM temelli etkinliklerin erken cebir öğretiminde uygulanabilir olduğunu ifade eden öğretmenler bu uygulamaların; matematik dersine yönelik olumlu tutum kazandırma, eğlenerek öğrenme ortamları sunma, öğrenmeyi kolaylaştırma, soyut olan konuları somutlaştırma gibi avantajlarının olacağı belirtilmiştir. Ayrıca öğretmenler; materyal eksikliği, sınıf mevcutlarının kalabalık olması, müfredatın yoğun olması, teknolojik alt yapı yetersizliği gibi zorluklar yaşadıklarını belirtmişlerdir. Öğretmenler, erken cebir öğretiminde STEM temelli uygulamaları yürütecek öğretmen ve yöneticilere; bu alanda araştırma inceleme yapmalarını, STEM eğitimi almalarını ve sınıflarında uygulamalarını önermektedir.

1. Introduction

1.1. STEM

STEM is an acronym created by combining the initials of the words Science, Technology, Engineering, and Mathematics (Bybee, 2010; Gonzalez & Kuenzi, 2012; Langdon et al., 2011). Although the concept of STEM, which is an interdisciplinary approach that includes the disciplines of Science, Technology, Engineering, and Mathematics, is holistic, these fields intersect with each other (Chen, 2009; Dugger, 2010; Gilmer, 2007; Taljaard, 2016; Thomas, 2014). Carnevale, Melton, and Smith (2011) defined STEM education as the adoption of a purposeful, meaningful, and holistic approach to the learning process of individuals by basing on interdisciplinary integration and establishing a link between disciplines.

The STEM education approach is one of the most effective educational approaches among 21st-century skills that include high-level skills such as problem-solving, logical reasoning, creative thinking, effective communication, and critical thinking (Mercan, 2019). The fields of science, mathematics, engineering, and technology play an important role in gaining high-level skills such as research, inquiry, creativity, analytical thinking, critical thinking, logical reasoning, and decision-making skills that we expect qualified individuals to have (Yamak et al., 2014).

The foundations of the STEM education approach go back more than a century. This approach was put forward by the Committee of Ten at Harvard University towards the end of the 1800s, to reach a standard for schools in which agricultural studies were conducted (Ostler, 2012). In 1990, "SMET" was used as an abbreviation of the words "science, mathematics, engineering, technology" by the National Science Foundation (Sanders, 2009). In 2001, the "National Science Foundation" was first used by NSF as an abbreviation of "STEM" to express integrated programs in the fields of science, technology, engineering, and mathematics (Harkema et al., 2009). One of the factors in the emergence of the STEM approach is shown to be less inclination of students to doctoral programs related to science and engineering in the United States of America (Çorlu et al., 2014). The STEM education movement, which was put forward by leaders and politicians, is accepted as a reform movement that emerged to ensure that the USA has an active role in the global economy (Dugger, 2010; Wang et al., 2011). As a result of the reports published by organizations such as ASEE (American Engineering Education Society), NAE (National Engineering Academy), and ITEEA (International Technology and Engineering Education Association) for STEM education in the USA, the 21st century. The need for an increase in the number of qualified individuals who can fulfill the requirements of the age has drawn attention. These reports made an impact in many countries,

especially the USA, and paved the way for the rapid spread of STEM education (Çepni, 2017). In many countries, especially in countries such as the USA, Japan, Korea, and China, studies on STEM education at preschool, primary, and secondary education levels have begun to be carried out to create an innovative society (Gonzalez & Kuenzi, 2012; Yılmaz et al., 2017).

With the increase in the importance and budget given to STEM education in developed countries and the effect of STEM in reaching the level they aimed as a result, the needle of my education in Turkey was turned to STEM. Studies in the field of STEM have begun under the leadership of scientists (Azkin, 2019). To develop and disseminate STEM education in Turkey, some targets have been determined in the 2015-2019 Strategic Plan (Wendell et al., 2010). In the STEM Education Report prepared by MoNE YEGITEK in 2016, the aims of strengthening STEM were included (MoNE, 2016). Since the expected level of success could not be achieved in PISA and TIMSS exams in Turkey, research was conducted on the reasons for this. The education policies of countries such as America and South Korea, which have high success levels in PISA and TIMSS exams, have been examined and education policies for STEM education have been adopted in our country, as in many other countries in the world (Akgündüz et al., 2015). While the Scientific and Technological Research Council of Turkey (TUBITAK), which supports the Ministry of National Education in the STEM field, included supportive statements in the field of STEM in its 2017-2023 National Science, Technology and Innovation Strategy Report, science fairs should be organized to make primary and secondary school students love science. TÜBİTAK provides support to students, teachers, and academics in STEM education. Science centers carry out activities to popularize and popularize science among primary and secondary school students (TÜBİTAK, 2016).

STEM education aims to use the subjects of Science, Technology, Engineering, and Mathematics holistically with an interdisciplinary approach, by establishing a relationship with the subjects in real life to train future engineers, scientists, and technologists who have a high level of scientific creativity, can innovate and can compete in the global economy (Breiner et al., 2012; Sanders, 2009). Students who receive STEM education will contribute to sustainable development and a strong economy with technological innovations as future scientists, engineers, and mathematicians (Ensari, 2017). Thomas (2014) explains the aims of STEM as follows: To provide job opportunities to individuals who have gained STEM literacy, to offer innovative ideas to countries in the development of the economy, and to have competence in new business areas.

The information and technology era you live in shows a rapid acceleration is expected that people will have the qualifications to adapt to this acceleration. Therefore, there is a need for qualified individuals who research,

question, criticize, be analytical, and have decision-making skills (Yamak et al., 2014). STEM education approach has an important place in gaining these skills. STEM provides the opportunity to have the knowledge and skills that the individual needs (Beane, 1991). The main purpose of STEM is to provide knowledge and skills in science, mathematics, engineering, and mathematics disciplines to contribute to the solution of daily life problems by producing creative solutions (Thomasian, 2011).

1.2. The Discipline of Mathematics in STEM

Mathematics is conceptually a way of thinking and reasoning, with the techniques of calculating and measuring using numbers. Mathematics enables us to analyze data and synthesize organized data by creating strategies. Mathematics is a newly learned language for students. Students need to learn numbers and symbols to learn this language. Numbers and symbols have an important place both in mathematics and in our daily life (Pesen, 2020). The acquisition of mathematical skills affects individuals to live independently, increase education and employment opportunities, and develop socioeconomic status in today's society. How mathematical skills are acquired, what kind of difficulties are experienced in gaining these concepts, and overcoming these difficulties are extremely important (Mutlu, 2020). Thanks to mathematics, individuals make sense of facts and events using mathematical concepts and relationships (Olkun & Toluk, 2003). Thanks to mathematics, he tries to make the unknown structure of the universe known. Individuals with knowledge and skills in the discipline of mathematics will be pioneers in many areas in their future lives (MoNE, 2009).

In the STEM education approach, mathematics is frequently included in every discipline area (Mayorova et al., 2021). Therefore, one of the most important components of STEM education is mathematics (MoNE, 2006). Problem-solving, critical thinking, and analytical thinking skills, which are the basis of STEM education, can be developed by using mathematics (Maass et al., 2019). In this context, the discipline of mathematics has an indispensable role in STEM education and mathematics education has many effects on STEM applications (Cooke & Walker, 2015). While STEM applications make a positive contribution to the development of students' mathematical reasoning skills and higher-order thinking skills, they also improve mathematical literacy skills (Weber et al., 2013). STEM education provides an increase in mathematics academic skills (Acar et al., 2018; McClain, 2015), and it reflects positively on their attitudes toward mathematics (Koçyiğit & Yenilmez, 2022).

Although mathematics is considered important by everyone, learning and teaching mathematics is a very difficult process. Mathematical thinking skills have an important effect on learning and teaching mathematics more effectively and healthily. Mathematical thinking skills differ in mathematics depending on the nature of the

mathematical techniques that take place in various fields such as geometry, arithmetic, algebra, and probability (Dindyal, 2003). Mathematics is an important tool in the development of thinking skills. (Umay, 2003).

1.3. Early Algebra

The "Primary School Mathematics Curriculum in Turkey consists of four learning areas: Numbers and Operations, Geometry, Measurement, and Data Processing." Although the acquisitions related to the algebra learning field are not included at the primary school level, they appear for the first time at the 6th-grade level (MoNE, 2018). Although the achievements of the algebra learning field are not included in the primary school mathematics curriculum, generalization in arithmetic, being able to generalize from equations and symbolic explanations, generalizing in series, generalizing the rules establishing numerical relations to other situations, simplification and arrangement, inverse relationship, working with unknowns, understanding the connections between equality and inequality, Algebra and subjects that make up the infrastructure of algebra such as being able to see the functions in symbols and the relationship between different presentations, awareness of the mathematical structure, making explanations and verifications, estimation and backward working, problem-solving are included (Turgut, 2016).

Although all fields are necessary in mathematics, the algebra learning field has an important place in solving problems that exist in daily life (Altun, 2005). Algebra has different functions. It is possible to express algebra as a mathematical language, thinking tool, problem-solving tool, or a school lesson (Dede & Argün, 2003). Sutherland and Rojano (1993) described algebra as a language to explain ideas. Sfard (1995) expressed algebra as a science of computation. According to Usiskin (1997), algebra is a mathematical language classified as "unknowns, formulas, patterns, placeholders, and relations". On the other hand, Turgut and Temur (2017) define algebra in the most general sense as "the expression of unknown values in mathematics with letters or various symbols, and putting forward an equation for the solution of unknowns based on knowns".

Algebra has existed since the first years of education (Carraher et al., 2017) and algebraic thinking begins to develop from early grades (Cai & Knuth, 2011). Early algebra is the transitional process between arithmetic and algebra. Kieran (1991) defined early algebra as the process in which arithmetic experience forms the basis of algebra and algebraic thinking begins to develop. In Turkey, algebra teaching in the Mathematics Curriculum is included in the primary school level, patterns and ornaments sub-learning domain (MoNE, 2009). In the 2015 Mathematics Curriculum, there was a sub-learning area of transition to algebra at primary school (1, 2, 3, and 4th grades). Algebraic concepts such as patterns, generalization, and variables were emphasized in the program,

which was put into practice since the 2016-2017 academic year (MoNE, 2015). While it is right to teach students algebraic thinking and reasoning skills at a young age, it is necessary to pay attention to appropriate learning tools and methods (NCTM, 2000; Yackel, 1997).

1.4. Integration of Stem-Based Applications in Early Algebra Teaching

It is possible to talk about three approaches in the integration of the curriculum: multidisciplinary, interdisciplinary, and supra-disciplinary (Drake & Burns, 2004). In the multidisciplinary approach, concepts, and skills are taught separately for each discipline on a common theme. The in-depth teaching of two or more disciplines is provided by an interdisciplinary approach. The transdisciplinary approach, on the other hand, is taught by focusing on real-life problems based on two or more disciplines (English, 2016). Although STEM is an interdisciplinary approach, it seems that it has been integrated with many fields since its emergence and moved to a transdisciplinary dimension. In STEM education, science, technology, engineering, and mathematics should be integrated (Morrison et al., 2019). The discipline of mathematics has a lot of influence on the STEM approach (Cooke & Walker, 2015). Algebra is one of the sub-discipline areas within the discipline of Mathematics. In this context, studies on early learning can be carried out by providing STEM integration in algebra teaching.

2. Method

The phenomenology design, one of the qualitative research designs, was used in this study, which aims to reveal the experiences of primary teachers regarding the implementation of STEM-based applications in early algebra teaching. Phenomenology is a research design that aims to investigate the phenomena that occur in the face of events, perceptions, experiences, concepts, orientations, and situations that exist in daily life that we are aware of but do not have a deep understanding of (Yıldırım & Şimşek, 2021). In phenomenological research, the researcher reveals the common aspects of the participants who have experienced a phenomenon and handles it as it is from the perspective of the experienced people (Bocheński, 2008; Creswell, 2021; Giorgi, 1985). In phenomenological studies, participants reveal how they perceive the situations they have experienced from their perspectives (Balcı, 2021; Saban & Ersoy, 2019).

2.1. Study Group

The study group of this research consists of 5 primary teachers who apply the STEM education approach in early algebra teaching. The purposive sampling selection method was preferred in the study (Miles & Huberman, 1994). In the purposive sampling method, it is possible to study the situations that are assumed to be rich in

information in depth (Patton, 2014; Tanrıöğen, 2014). The individuals at the center of the research consist of people who experience the phenomenon and can express this phenomenon (Yıldırım & Şimşek, 2021). The criterion sampling method, which is one of the purposeful sampling methods, was preferred because of the study of cases that met a set of predetermined criteria in the study (Büyüköztürk et al., 2021; Yıldırım & Şimşek, 2021). Criteria in the selection of primary teachers included in the research was determined that STEM education was taken and that STEM-based applications were included in early algebra teaching. Within the framework of research ethics, the personal information of the participants was not included, and coding was done with numbers and letters. Participants were named with the codes T1, T2, T3, T4, and T5. Table 1 includes the demographic information of the teachers in the study group.

Table 1.

Demographic information about the study group

Participants	Age	Gender	Seniority
Teacher 1	39	Female	16
Teacher 2	51	Female	24
Teacher 3	37	Female	14
Teacher 4	32	Female	8
Teacher 5	36	Male	10

According to Table 1, the ages of the participating teachers vary between 32 and 51 and their average age is 39. Four of the participating teachers are female and one is male. Their professional seniority is between 8 and 24 years and the most senior teacher has 24 years of teaching experience.

2.2. Data Collection Tools

A semi-structured interview form developed by the researcher was used as a data collection tool in the research. Semi-structured interviews are powerful data collection tools that individuals reveal by reflecting their feelings, thoughts, opinions, and experiences on their voices (Wengraf, 2001). With the semi-structured interview form, the questions asked to the researcher during the interview are supported with different questions in the process, various dimensions are addressed, and new ideas are revealed (Merriam, 2015; Yıldırım & Şimşek, 2021). The researcher has the flexibility to immediately ask questions about the issues that were not clarified in the interview. It can catch clues to examine the superficial information given by the participants in-depth (Çepni, 2010; Karasar, 2022).

In this study, a measurement tool consisting of 14 open-ended questions under 5 sub-problems developed by the researcher and finalized by taking expert opinion was used as a data collection tool. Semi-structured interview form was carried out by using the Zoom application online with 3 teachers and by face-to-face interviews with 2 teachers. To avoid data loss during the interviews, voice recording was taken with a voice recorder after obtaining the consent of the participants. The recorded sounds were then converted to text without skipping data.

2.3. Data Analysis

Content analysis technique, one of the qualitative analysis methods, was used in the analysis of the data of the research conducted to examine the views of teachers on the implementation of STEM-based applications in early algebra teaching. The main purpose of content analysis is to enable the researcher to reach the concepts and relationships that he can explain the data he collects. While performing content analysis, it is necessary to interpret it by categorizing and arranging it in a way that the reader can make sense of, within the framework of certain concepts and themes that have similarities with each other (Yıldırım & Şimşek, 2021). In content analysis, raw data is coded and converted into standard formats (Babbie, 2007). There are four stages in the interpretation of data in content analysis. These stages are coding the data, finding the themes, organizing the codes and themes, and defining and interpreting the findings (Yıldırım & Şimşek, 2021).

While analyzing the data in the research, the data obtained by the researcher were examined and divided into meaningful sections. The conceptual meanings of these parts were found. Codes were created by dividing each section into subsections. The coded data were systematically tabulated to be categorized under certain themes and sub-themes. Tables containing the themes, sub-themes, codes, and frequency values that emerged after the analysis are presented in the findings section.

2.4. Validity, Reliability, and Ethics

Various precautions were taken by the researchers to minimize or eliminate the factors that affect and threaten the validity and reliability of the research (Yıldırım & Şimşek, 2021). In qualitative research, diversification is used to increase internal validity (credibility). According to Yıldırım and Şimşek (2021), diversification is defined as the whole efforts to increase the credibility of research results by using different methods in data sources, data collection, and data analysis (Yıldırım & Şimşek, 2012). In the process of creating the semi-structured interview form, which will be used as a data collection tool in the research, the literature was examined, and draft questions were created. The semi-structured interview form prepared as a draft was submitted to the opinion of 6

academicians who are experts in the field to ensure internal validity. After the feedback from the experts, the semi-structured interview form was edited and given its final shape. Before the semi-structured interview form was applied to the participants, the pilot application was applied to two primary teachers to determine the suitability of the interview form for the study. It was tested whether the questions in the piloted form were clear and understandable, the final arrangements were made, and the application was started. The teachers who will participate in the research were informed in detail about the research beforehand, and a consent form was obtained indicating that they participated in the study voluntarily. The names of the teachers in the study group of the research were not reflected in the study in any way and were kept confidential. In the study, the real names of the teachers were not included, and codes were given to all participants regardless of gender. The data were transferred to the participants in the research by giving the codes T1, T2, T3, T4, and T5. The interviews conducted by the researcher individually with the participants lasted an average of 50 minutes. The participants were assured that the records could only be accessed by the researcher, their consent was obtained, and the interviews were recorded with a voice recorder to avoid data loss. After the interview, the audio recordings were converted into text and the texts were presented for the approval of the participants. It has been confirmed that the interview reports are correct and complete, and in this way, internal reliability is ensured.

To increase the validity and reliability of the findings presented in the study, frequent quotations were made from the views of the participants. The study group selection of the research, data collection tools, and data collection process are described in detail. Within the framework of the results obtained by the researcher, the codes were extracted, and these codes were compared with each other. By interpreting and conceptualizing the obtained codes, they formed patterns that the participants were not aware of (Yıldırım & Şimşek, 2021). Adhering to the problem and purpose of the research, unnecessary codes were removed, or new codes were added. In this way, deep-focused data were obtained with the thought of contributing to the reliability of the research.

To ensure internal consistency (reliability) in coding, the data were analyzed separately by each researcher and the reliability formula suggested by Miles and Huberman (1994) was used for reliability calculation. To ensure the consistency of the data within the scope of reliability in the research, the expert opinion of the external auditor, who was excluded from the study, was consulted in the analysis and reporting processes, and the themes and sub-themes obtained were compared with the literature findings. In addition to the researcher, a second coding was made by the external auditor and the score of compatibility between the two codings was calculated. The fit formula developed by Milles and Hubberman (1994) was used to calculate the fit score among the coders.

Reliability Coefficient = Number of Consensus / (Total Consensus + Disagreement)

As a result of the content analysis made with the Miles and Hubberman (1994) formula, the percentage of coding compliance was found to be 0.92%. A concordance of over 70% indicates that there is a concordance between the two coders and is considered reliable for the research.

To ensure external validity in the research, detailed descriptions of the research model, study group, data collection tools, data collection, data analysis, and how the findings were organized were stated. Within the scope of external validity (transferability) in the research, the purposive sampling method was used and suitable individuals were determined to serve the purpose of the study, based on the criteria that the participants had received education in the field of STEM and included STEM-based applications in early algebra teaching.

3. Result

In this section, the findings obtained as a result of the interviews with the primary teachers who carry out STEM-based applications in early algebra teaching are presented under the titles of research sub-problems in the semi-structured interview form. Under the sub-problem titles, the analysis of the questions to be researched on that subject is given. Each sub-problem contains more than one question. In the analysis of the data, tables were created by classifying sub-themes and similar themes with the codes created within the framework of the answers given by the teachers. In the tables, it was tried to present a holistic and deep perspective by giving place to the example expressions and one-to-one quotations of the teachers.

3.1. Opinions of Primary teachers Carrying out STEM-Based Practices in Early Algebra Teaching on their Competence in the Field of STEM

STEM Education Approach and STEM-Based Practices

"What do you know about STEM-based applications? What do you think STEM is?" questions were highlighted. The findings regarding the views of teachers about the STEM education approach and STEM-based practices are presented in 2. Table.

Table 2.

STEM Education Approach and STEM-Based Practices

Themes	Sub Themes	*f*	Example Statements from Teachers' Opinions on STEM Education Approach and STEM-Based Practices
Approach	Interdisciplinary approach	5	*"I know that STEM education is an interdisciplinary educational approach that integrates science-technology-engineering and mathematics." T1*
	Science-technology-engineering-mathematics disciplines	5	
	Integrated approach	3	
	Process-based approach	3	
	Art approach	2	
	Design-based approach	1	
Developed skills	Engineering skills	4	*"They are activities for applications that develop engineering skills that enable them to use many technological tools as well as develop their 21st-century skills." T2*
	Ability to use technology	3	
	21st-century skills	2	
	Problem-solving skill	2	
	Design skill	1	
	Robotics and coding skills	1	*"STEM is an approach to solving real-life problems that allow it to solve this problem in connection with 4 basic discipline areas." T5*
	Communication skill	1	
Required competency	Creativity	3	*"It is an interdisciplinary learning approach that supports creative thinking by creating generations that produce STEM-based applications." T3*
	Innovation	3	
	Productivity	2	
	Originality	1	
Application method	Project-based learning method	3	*"For example, the 5E learning model should be in STEM. We know it as a process-based, design-oriented approach in which group work is important, including various method techniques." T5*
	Group work method	2	
	Research-based learning approach	1	
	Collaborative learning method	1	
	5E model	1	
The purpose	Real-life problems	3	*"There are real-life problems in STEM, and after these problems were determined, we set out from 4 disciplines, even in art, some methods are applied to solve them." T4*
	The process of perceiving the world	1	

When Table 2 is examined, the findings of the primary teachers who carry out STEM-based practices in early algebra teaching regarding STEM education approach and STEM-based practices are gathered under five main themes: approach, skills developed, necessary competencies, application method, and output purpose. In the approached theme, there are sub-themes of an interdisciplinary approach, Science-Math-Engineering-Mathematics disciplines, integrated approach, process-based approach, art approaches, and design-based approach. The developed skills theme includes engineering skills, technology use skills, 21st-century skills, problem-solving skills, design skills, robotic coding skills, and communication skills. There are sub-themes of creativity, innovation, productivity, and originality under the theme of required competencies. Project-based learning approach, group work method, inquiry-based learning approach, cooperative learning method, and 5E

learning model approach are sub-themes under the application method theme. The sub-themes of the exit purpose theme are daily life skills and the process of perceiving the world.

STEM Field Competency

To the primary teachers who participated in the research, "Where and from which institution did you receive your STEM education? Could you give information about its content, level, duration of the training, etc.? questions were asked. Findings regarding STEM field competence are presented in Table 3.

Table 3.

STEM Competency

Themes	**Sub-Themes**	***f***	**Example Statements from Teachers' Opinions on STEM Field Competence**
Content of the training	Preparing lesson plan acorrding to 5E model	5	*"We learned the application and steps of the STEM approach. It was a training that taught how to develop applications for the 5E plan in practical training." T2*
	Application-based studies	5	
	STEM application steps	4	
	Engineering processes	3	*"We received training on preparing a lesson plan according to the 5E method and then using practical activities" T4*
	Write a problem situation	1	
	Modeling	1	
Level of education	Basic level	5	*"In STEM education, I first took the STEM basic level course. First, I took it through a course that was opened centrally by the ministry. Later on, we took the advanced level course." T3*
	Advanced level	4	
	Instructor training	3	
Training institution	In-service training under the Ministry of National Education	4	*"Although the training was online, it was a hands-on training and lasted for two months. It was quite full of content. We prepared a lesson plan according to the 5E model." T1*
	Online education	3	
	Distance education within the university	2	

When Table 3 is examined, the findings regarding the STEM field competencies of the primary teachers who carry out STEM-based practices in early algebra teaching are gathered under three themes: the content of the education, the level of education, and the institution of education. The content theme of the training includes preparing a lesson plan according to the 5E model, application-based studies, STEM application steps, engineering processes, problem writing, and modeling sub-themes. Basic level, advanced level, and trainer sub-themes are the sub-themes within the scope of the level of education theme. In the theme of the institution where the education is received, the sub-themes of in-service training within the Ministry of National Education, online training, and distance education within the university.

Conducting STEM-based activities

To the primary teachers who participated in the research, "Do you conduct STEM-based activities in your lessons? Could you tell us about the activities you are carrying out now or in the past?" questions were asked. Findings for conducting STEM-based activities are presented in Table 4.

Table 4.

Conducting STEM-Based Activities

Themes	**Sub-Themes**	***f***	**Example Statements from Teachers' Opinions on Receiving STEM Education**
Science based	Decaying	1	*"The students were asked to design a house with sound insulation as a result of the noise problem they experienced in the classroom and a sound problem coming from outside." T2*
	Earthquake-resistant house model	1	
	Recycle	1	*"In addition, we bring the fruits to the classroom for days so that they can make one-on-one observations of the children, and we watch the decay by showing the change of the class from day to day." T3*
	Frictional force	1	
	Sound insulation	1	
	Electrical circuit	1	
	Sustainability	1	
Technology based	Robotic coding	3	*"We showed how to classify living things using Minecraft by designing a New World in Minecraft game" T3*
	Minecraft	1	
	Lego sets	1	*"I provide STEM education with the First lego kits of the science heroes association." T5*
	Scratch	1	
Mathematics based	Four operation skills	3	*"I can do it in advanced subjects, but I did activities on patterns in fractions in my previous classes." T4*
	Fractions	1	
	Length measurements	1	
	Patterns	1	
Art based	Drama	1	*"We bring real-life problems to life with drama." T1*

According to the findings obtained for the execution of STEM-based activities according to Table 4, there are four themes: science-based applications, technology-based applications, mathematics-based applications, and art-based applications. Science-based applications themes are decaying, earthquake resistant house model, recycling, friction force, friction force, sound insulation, weather, and sustainability. Robotic coding, Minecraft, lego sets, and Scratch are sub-themes under the theme of technology-based applications. Under the theme of mathematics-based applications, there are sub-themes of four operation skills, fractions, length measures, and patterns. Drama is the sub-theme under the theme of art-based practices.

Class Levels and Implementation Times of STEM-Based Activities

"How long have you been conducting STEM-based applications? At which grade levels did you include these applications?" questions were asked. The findings regarding the conduct of STEM-based activities are presented in Table 5.

Table 5.

Class Levels and Implementation Times of STEM-Based Activities

Themes	Sub-Themes	*f*	Example Statements from Teachers' Opinions on Class Levels and Implementation Periods in which STEM-Based Activities are Conducted
Grades	4th grade	5	*"I continued the studies from where I left off from the 3rd grade." T1*
	3rd grade	5	*"I couldn't apply many activities at the 1st-grade level. I did it in 4th graders. There were studies that I applied in 3 classes." T4*
	2nd grade	3	
	1st grade	2	*I give STEM-based applications in the 2nd, 3rd, and 4th grades. Some more difficult applications are carried out in the 1st grades." T5*
Application time	For 2 years	3	*"I have been running STEM-based applications for 4 years." T3*
	For 4 years	2	*"I have been conducting STEM-based studies for about 2 years." T5*

When Table 5 is examined, there are two themes, grade level, and grade level, according to the findings obtained regarding the grade levels and application times in which STEM-based activities are carried out in early algebra teaching. 4th-grade, 3rd-grade, 2nd-grade, and 1st-grade sub-themes were determined under the class levels theme, and 2 years and 4 years sub-themes under the application durations theme.

3.2. Opinions of Primary School Teachers Carrying Out STEM-Based Practices in Early Algebra Teaching on Algebra Content Knowledge

Early Algebra Teachability Level and Early Algebra Content Knowledge

To the primary teachers who participated in the research, "Do you think algebra can be taught to primary school children? What do you think early algebra teaching means?" questions were asked. Findings on early algebra teachability and what early algebra means are presented in Table 6.

Table 62.

Early Algebra Teaching

Themes	Sub-Themes	*f*	Example Statements from Teachers' Opinions on Early Algebra Teaching
Subject areas	Shapes used in place of unknowns/Placeholders	5	*"Early algebra is when a student learns these relationships with patterns and spatial relationships with shapes away from numbers and forming links for shapes." T2* *"We started with spatial relations in 1st grade. It's a bit closer to algebraic expressions in spatial relations. The equality expression can be used later." T3*
	Patterns	4	
	Symbols	3	
	Geometry	2	
	Formulas	2	
	Equal sign	2	
	Numbers	2	
	Spatial relationships	2	
	Shapes	2	
	Length measurements	1	
Developmental impact	Early life	1	*"At the same time, giving these studies to students from an earlier age is to give early algebra application at an early age. T1* *"Early algebra practice enables students to use a more disciplined method of learning and connect." T4*
	Establishing a bond	1	

All of the primary teachers who carry out STEM-based practices in early algebra teaching stated that algebra can be taught in the early period. The findings regarding the opinions of the teachers participating in the research are examined in two themes: the subject area that can be taught algebra and the developmental effect. Under the theme of subject areas, there are sub-themes of shapes (placeholders), patterns, symbols, geometry, formulas, equal signs, numbers, spatial relations, shapes, and length measures used instead of unknowns. Early period and bonding are sub-themes under the developmental impact theme.

Level of Teaching Algebra and Starting Teaching Algebra Topics

"At what age should children start learning algebra? So what algebra subjects can be taught at this age? From where?" questions were asked. The findings regarding the level of early algebra teaching and the subjects that are considered to start early algebra teaching are presented in Table 7.

Table 7.

Learning Age of Algebra / Topics to Begin Teaching

Themes	Sub-Themes	*f*	Example Statements from Teachers' Opinions on the Age of Learning Algebra and Which Topics to Start in Algebra Teaching
Subject area to be started	Patterns	4	*"The first thing that comes to my mind in early algebra teaching is the use of spatial relations. First of all, it can be started from these topics, that is, concepts such as behind, in front, on the right, on the left, and the bottom can be given." T2*
	Spatial relationships	3	
	Geometrical shapes	2	
	Numbers	2	*"As a symbol, if we consider numbers as a symbol, it can be given. Of course, spatial relations can also be given within this subject." T5*
Age group/grade	4 years old	4	*" I think it can be started at the simplest level, starting from the 1st grade. Maybe it can even be reduced to kindergarten because the first concepts taught in the name of mathematics start from preschool." T1*
	1st grade	4	
	4th grade	1	*"Early algebra education should start from the preschool period, or it can be started within the age group of 4, I say pre-school, my teacher, it has to be pre-school." T4*

Table 7 shows the findings regarding the opinions of teachers who carry out STEM-based practices in early algebra teaching. Algebra is examined in two themes, which are the subject area that is thought to start teaching and age group/class level. Subject areas thought to have not started to be taught in algebra are patterns, spatial relations, geometric shapes, and numbers. Preschool age 4, 1st-grade, and 4th-grade sub-themes are given as sub-themes under the age group/grade level theme.

Applications in Early Algebra Teaching

To the primary teachers who participated in the research, "Have you carried out any practice in your classroom for teaching algebra? Can you give information?" questions were asked. In light of the answers given by the teachers participating in the research, the findings regarding the practices they carried out in teaching algebra are presented in Table 8.

Table 8.

Application Areas in Early Algebra Teaching

Theme	Sub-Themes	*f*	Example Statements from Teachers' Opinions on Practices in Early Algebra Teaching
Application areas in early algebra teaching	Geometric shapes and objects	3	*"When I was talking about weighing, I explained it not numerically, but with objects. For example, 2 oranges are equal to the weight of an apple. We conducted studies in the dimension of comparing weights and establishing relationships." T2*
	Greater-less than sign	2	
	Four operations skills	2	
	Spatial relationships	2	
	Length measurements	2	
	Placeholders	2	
	Teaching numbers	2	*"I generally use it in four-operation skills to concretize mathematics for children. You know, we use symbols very often while this addition operation gives unknowns in subtraction." T4*
	Unknowns	1	
	Graphics	1	
	Measurement	1	
	Patterns	1	*"We can put a shape in any box, and we can use placeholders when dealing with unit cubes." T5*
	Symbols	1	
	Weighing	1	

When Table 8 is examined, the findings regarding the opinions of the teachers who carry out STEM-based applications in early algebra teaching are geometric shapes and objects, the concept of greater-than-less than, four operation skills, spatial relations, length relations, placeholders, number teaching, unknowns, graphics, under the theme of application areas in algebra teaching, measuring, patterns, symbols and weighing were examined in thirteen sub-themes.

3.3. Opinions of Primary School Teachers Who Carry out STEM-Based Practices in Early Algebra Teaching on the Integration of STEM Education Approach to Early Algebra

Early algebra integration of STEM education approach

To the primary teachers who participated in the research, "Can STEM applications be used while teaching algebra to primary school children? How did you include STEM-based applications in early algebra teaching? Can you explain?" questions were asked. In light of the answers given by the teachers participating in the research, the findings regarding the early algebra integration of the STEM education approach are presented in Table 9.

Table 93.

Implementing STEM-Based Practices in Early Algebra Teaching

Theme	Sub-Themes	*f*	Example Statements from Teachers' Opinions on the Implementation of STEM-Based Practices in Early Algebra Teaching
STEM-based activities applied in early algebra teaching	Geometric shapes and objects	4	*"The hangers we were going to make for our class came in different models. We were just going to deal with the pattern issue. We designed this subject and I stated that we would apply the best result on our hanger." T2*
	Length measurements	3	
	Robotics and coding	2	
	Statistics	1	
	measuring	1	
	patterns	1	*"We made a STEM application using distance, that is, length measurements. We made simulations by building houses with Legos. We did the earthquake simulation with robotic coding and created a real shape." T3*
	Weighing	1	
	Spatial relationships	1	
	Measuring time	1	*"While giving the length relations, I conducted studies by establishing relations with other subjects both with lessons and with mathematics." T4*

When Table 9 is examined, the theme of STEM-based activities applied in early algebra teaching according to the findings obtained in the implementation of STEM-based applications in the early algebra teaching of the teachers participating in the research is included. Within the scope of this theme, there are sub-themes of geometric shapes and objects, length measures, robotic coding, statistics, measurement, patterns, weighing, spatial relations, and measuring time.

Methods and Techniques Used in the Realization of STEM-Based Applications in Early Algebra Teaching

To the primary teachers who participated in the research, the "Instructional technology and materials should be used to successfully apply the STEM approach in early algebra teaching?" question was asked. In light of the answers given by the teachers participating in the research, the findings on which method and technique should be used to successfully apply the STEM approach in early algebra teaching are presented in Table 10.

Table 4.

Methods and Techniques Used in the Implementation of Applications

Themes	Sub-Themes	*f*	Example Statements from Teachers' Opinions on the Methods and Techniques Used in the Implementation of STEM-Based Practices in Early Algebra Teaching
Methods and techniques	Project-based learning method	5	*"I used experiments method, brainstorming, project-based learning, computer-assisted teaching, learning by doing research, learning by doing, modeling, drama methods, and techniques in STEM applications in early algebra teaching." T1* *"Especially in the STEM approach, the project method, the 5E learning model, is widely used in our country. In other words, the 5E learning model is a method that we use more. Drama is used at a much younger age." T3* *"We used the 5E model in our projects. In general, there are certain stages of this, there are design stages. You know, we already used the project-based project-based teaching method in our studies." T4*
	Role-playing/Dramatization	5	
	Problem-based learning method	5	
	Teaching through inquiry	4	
	5E model	3	
	Brainstorming technique	2	
	Computer-assisted instruction	2	
	Context-based learning	2	
	Inventive learning method	2	
	Method of learning by doing	1	
	Test method	1	
	Design-based learning approach	1	

When Table 10 is examined, under the theme of the methods and techniques used by the teachers participating in the research while conducting STEM-based activities in early algebra teaching, project-based learning method, role-playing/dramatization, problem-based learning method, inquiry-based teaching method, 5E learning model approach, brainstorming technique, computer-assisted teaching, context-based learning, discovery learning method, learning by doing, experimental method and design-based learning approach

3.4. The Opinions of Primary School Teachers Who Carry out STEM-Based Practices in Early Algebra Teaching on the Applicability of STEM Education Approach in Early Algebra Teaching

Applicability Level of STEM Education Approach in Early Algebra Teaching

To the primary teachers who participated in the research, "What level do you think the applicability level of the STEM education approach is in early algebra teaching in the current system? From where?" questions were asked. In light of the answers given by the teachers participating in the research, the findings regarding the applicability of the STEM education approach in early algebra teaching are presented in Table 11.

Table 5.

Applicability Level of STEM Education Approach in Early Algebra Teaching

Themes	Sub-Themes	*f*	Example Statements from Teachers' Opinions on the Applicability Level of the STEM Education Approach in Early Algebra Teaching
Applicability	Insufficient	5	*"The applicable level is a bit difficult in the current system. I think it's not enough." T2*
	Difficult	5	
The dimension associated with the education system	Intensive curriculum	4	*"If you try to integrate into STEM, you can do it on your own. It is a little difficult to do activities for gains here. I think the source of our trouble is the gains." T3* *"If it were up to me, I would study all my lessons with the STEM approach, but the difficulties in raising the curriculum limit us a little." T5*
	Inappropriateness of the current system	2	
	Difficulty integrating STEM applications into learning outcomes	1	
	favorable physical conditions	1	
Knowledge and skill dimension	Teachers' lack of STEM practice skills	3	*"Besides, students have not been trained in this subject or the knowledge and skills on this subject do not have the readiness." T2* *"Of course, there has to be readiness. It's easier to put it on if it's ready. They learn more easily. Maybe they don't have any worries." T5*
	Students have no prior knowledge	3	
	Lack of prior knowledge of parents	2	
Attitudes dimension	Negative attitudes of teachers	3	*"There is also the fact that teachers do not volunteer and see this as a workload. They don't want to improve themselves. They do not have the knowledge and skills in the STEM field." T4*
	Negative attitudes of the school administration	2	
	Negative attitudes of parents	1	

When the findings regarding the applicability level of the STEM education approach in early algebra teaching are examined in Table 11, there are four themes of applicability, the dimension related to the education system, the dimension of knowledge and skills, and the dimension of attitudes. There are insufficient and difficult sub-themes under the theme of applicability. In the dimension related to the education system, there are sub-themes that the curriculum is dense, the current system is suitable, the integration of STEM applications into the learning outcomes is difficult, and the physical conditions are favorable. Teachers' lack of STEM application skills, students' lack of prior knowledge, and parents' lack of prior knowledge are the sub-themes within the scope of knowledge and skills. In the Attitudes dimension, there are sub-themes of negative attitudes of teachers, negative attitudes of school administration, and negative attitudes of parents.

Required Conditions for the Application of STEM Education Approach in Early Algebra Teaching

To the primary teachers who participated in the research, "What are the necessary conditions for the successful implementation of the STEM education approach in early algebra teaching? (Physical, social…)" was asked. In light of the answers given by the teachers participating in the research, the findings regarding the conditions required for the implementation of the STEM education approach in early algebra teaching are presented in Table 12.

Table 126.

Required Conditions in Application

Themes	**Sub-Themes**	***f***	**Example Statements from Teachers' Opinions on Necessary Conditions in the Application of STEM Education Approach in Early Algebra Teaching**
Physical conditions	Class size	5	*"I think that STEM education corners can be prepared. So this class layout can be made into merging rows that break down accordingly. In other words, we are trying to implement it over the old order. We are working by pushing the conditions." T2* *Class size must be appropriate. It is difficult in large classrooms. It is necessary to ensure the classroom order, to group the students, and to provide the appropriate environment for this." T4*
	Having STEM workshops	4	
	No shortage of material	4	
	Provision of technological equipment	3	
	Improvement of physical infrastructure	1	
	Ensuring adequate budget	1	
Attitudes	Positive attitudes of parents	4	*"Other than that, my work needs to be supported. Motivation needs to be internal motivation." T1*
	The supportive attitude of the school administration	3	
	Teachers' positive perspectives	3	*"At the same time, the parent needs to have the potential on this issue. They should contribute to the work we do." T3*
	Teacher motivation	2	
	Teachers are open to the development	2	
	Preliminary information on students and parents	2	*"The school administration should also offer support in this regard. You should not see your work as unnecessary." T5*
Content	Grade level compliance	4	*"Besides, the large number of classes and the intense curriculum is a major problem." T1*
	The curriculum is not intensive	3	

The conditions required for the execution of STEM-based applications in early algebra teaching were examined in three themes: physical conditions, attitudes, and content themes. Under the theme of physical conditions, there are sub-themes of low-class size, having STEM workshops, not experiencing material shortages, providing technological equipment, improving physical infrastructure, and providing an adequate budget. The theme of attitudes includes the sub-themes of positive attitudes of parents, supportive attitudes of school administration, the positive perspective of teachers, motivation of teachers, the openness of teachers to development, the openness of students and parents to development, and prior knowledge of students and parents. Compliance with the grade level and the lack of an intensive curriculum are sub-themes in the content theme.

3.5. The Opinions of Primary School Teachers Who Carry Out STEM-Based Practices in Early Algebra Teaching on the Problems and Suggestions Encountered in the Execution of STEM-Based Practices in Early Algebra Teaching

Advantages of Using STEM Educational Approach in Early Algebra Teaching

The primary school teachers who participated in the research were asked the question "Are there any advantages to including STEM-based applications while teaching early algebra?", "If you think there are advantages, can you explain them?". In light of the answers given by the teachers participating in the research, the findings regarding the advantages of applying the STEM education approach in early algebra teaching are presented in Table 13.

Table 137.

Advantages of the Application

Themes	Sub-Themes	*f*	Example Statements from Teachers' Opinions on the Necessity of STEM-Based Approaches in Early Algebra Teaching
Advantages	Gaining a positive attitude toward the mathematics lesson	5	*"For example, some children are afraid of math class. They are worried that I will not succeed. These apps make teaching so easy that they make it easier for children to learn even difficult subjects." T1* *"There may be parts that come easy, I can explain the difficult subjects more easily. Especially in mathematics classes, the averages are very low. Children perform lower in mathematics lessons than in other subjects. These studies cause students to love mathematics and science." T3* *"Students already love STEM applications. They are very enthusiastic about events. Everyone wants to bring something. Of course, this affects their attitudes towards school positively." T5*
	Providing fun learning environments	4	
	Making learning easier	4	
	Concretization	3	
	Contribution to the school-parent union	3	
	Increasing academic success	3	
	Reducing anxiety about math class	3	
	Enabling effective learning	2	
	Increasing student motivation	2	
	Increasing teacher motivation	2	
	Developing creativity	2	
	Making a positive contribution to career choice	1	

All of the teachers who participated in the research stated that there are advantages to applying the STEM education approach in early algebra teaching. The advantages of applying the STEM education approach in early algebra teaching were examined under a single theme, and under this theme, positive attitude towards the mathematics lesson, providing fun learning environments, facilitating learning, concretizing, contributing to parent-teacher unity, increasing academic success, reducing anxiety towards mathematics lesson, providing effective learning. There are sub-themes of increasing the motivation of the teacher and making a positive contribution to the choice of profession.

Problems Encountered in Executing STEM-Based Applications in Early Algebra Teaching

The primary teachers who participated in the research were asked the question "Did you experience any difficulties in the process of applying STEM-based applications while teaching algebra to your students?", "If you did, can you talk about these difficulties?". In light of the answers given by the teachers participating in the research, the findings regarding the problems encountered in the implementation of the STEM education approach in early algebra teaching are presented in Table 14.

Table 14.

The difficulties in the application

Themes	**Sub-Themes**	***f***	**Example Statements from Teachers' Opinions on the Problems Encountered in the Implementation of STEM-Based Practices in Early Algebra Teaching**
The difficulties	Lack of material	5	*"We do our work there. But of course, not every school has these opportunities. Of course, it is difficult to carry out these studies when these physical conditions are not met. In other words, there should be a tablet computer in the supply of materials and the use of technology." T1* *"There were problems in that group when a student from the group did not participate in the study or did not bring his material. Of course, we have a shortage of materials." T2"The problem for us is the density of the curriculum. For example, if the curriculum was not so intense, we could do more activities." T4"As the expectation of the parents is for more academic success, they may not give support. "T5*
	Large class size	5	
	Intensive curriculum	4	
	Lack of technological infrastructure	4	
	Lack of readiness of students	3	
	The negative attitude of school administration	2	
	Lack of physical infrastructure	2	
	Parent attitudes/expectations	1	

In Table 14, the problems encountered in the implementation of STEM-based applications in early algebra teaching are examined under a single theme, under this theme, the lack of materials, crowded classrooms, dense curriculum, insufficient technological infrastructure, lack of readiness of students, negative attitude of the school administration, lack of physical infrastructure and parent attitudes/expectations sub-themes.

Suggestions for Teachers and Administrators to Include STEM-Based Practices in Early Algebra Teaching

The *primary teacher*s were asked "Do you have any suggestions for teachers and administrators who will include STEM-based applications in early algebra teaching?" question was posed. In light of the answers given by the teachers participating in the research, the findings of the suggestions to the teachers and administrators regarding the implementation of the STEM education approach in early algebra teaching are presented in Table 15.

Table 158.

Suggestions to Teachers and Administrators

Themes	Sub-Themes	*f*	Example Statements from Teachers' Opinions on Suggestions to Teachers and Administrators in the Implementation of STEM-Based Practices in Early Algebra Teaching
Personal development dimension	Reviewing resources	4	*"The 21st century is a fast-moving time. We do not know what most of the future professions are and we are preparing this generation for those we do not know. Let them first open their horizons, develop themselves, change them." T3* *"I suggest they scan the available resources." T2*
	Conducting research	4	
	Reading articles, magazines	3	
	Watching educational videos	2	
	Improving yourself	2	
	Being innovative	1	
	Being creative	1	
Professional development dimension	Participating in in-service training	4	"They can do research, learn by reading articles from magazines." T1 "I recommend that they apply for in-service training provided by the national education and participate in online training." T2
	Get training from a STEM expert	3	
	Taking online training	2	
Application dimension	Making apps	3	*"By taking this training, they can both do activities and exercise, I recommend that teachers participate in such training and make practices." T4*
	Opening exercise	2	

In Table 15, there are three themes: personal development dimension, professional development dimension, and application dimension for suggestions to teachers and administrators who carry out STEM-based activities in early algebra teaching. Under the theme of personal development, there are sub-themes of examining resources, doing research, reading articles and magazines, watching educational videos, realizing oneself, and being innovative and creative. In the professional development dimension, there are sub-themes of participating in in-service training, receiving training from STEM specialists, and participating in online training. The sub-themes of making applications and opening exercises are the sub-themes within the scope of the application theme.

4. Discussion and Conclusion

This research was carried out to determine the opinions of primary teachers on the implementation of STEM-based applications in early algebra teaching. In this study, which was carried out using the phenomenology design in qualitative research designs, the opinions of the teachers participating in the research on the implementation of STEM-based applications in early algebra teaching were obtained using a semi-structured interview form prepared by the researcher, and expert opinion was taken. In the semi-structured interview form used as a data collection tool, five sub-problems and 14 open-ended questions were included under these sub-problems. The results obtained as a result of the answers given to the questions in the interview form by 5 primary

school teachers working in public schools affiliated with the Ministry of National Education, who received STEM education, taught early algebra in their classes, and carried out applications for STEM education approach in early algebra teaching, were presented under sub-problem headings.

4.1. Discussion and Conclusion on the First Sub-Research Question

In this part of the study, the results obtained by discussing the findings obtained from the views of the teachers by asking "opinions of the primary teachers who carry out STEM-based practices in early algebra teaching on their competencies in the field of STEM" are included. According to the findings obtained for the first sub-problem: all of the teachers expressed STEM as an interdisciplinary approach covering the disciplines of Science, Technology, Engineering, and Mathematics. In addition, teachers expressed the STEM education approach as an integrated and process-based approach. Bybee (2010) defines STEM as a Science Technology-Engineering-Mathematics-STEM (Science, Technology, Engineering, Mathematics) approach, and states that the STEM education approach is an interdisciplinary holistic approach created by integrating Science and Mathematics disciplines with Technology and Engineering disciplines. has done. In the studies conducted by Ramli and Talib (2017) and Süldür (2019), teachers defined STEM as science, technology, engineering and mathematics. According to the findings, teachers expressed that the STEM education approach can be integrated with the art discipline. Belardo (2015) remarked that the STEAM education approach is a bridge that bridges the gap between science and art and stated that science and art are similar in many ways and that STEM can turn into STEAM by including art. Teachers highlighted that STEM is a design-based approach.

The teachers participating in the research indicated that engineering skills, technology use skills, 21st-century skills, problem-solving skills, design skills, communication skills, robotics, and coding skills are among the skills developed by the STEM education approach. MoNE (2016) emphasized that STEM education has an important place in gaining high-level skills such as 21st-century skills. In this context, the STEM education approach contributes to the development of skills such as problem-solving skills, critical thinking skills, cooperation and communication skills, and creativity skills (Liao, 2016; Şahin et al., 2014).

In terms of the competencies gained by the STEM education approach, our teachers used the expressions of creativity, innovation, productivity, and originality. Siew (Siew, 2018; Siew et al., 2015) noted that the STEM education approach should be adopted in raising innovative individuals who are open to innovations, have scientific curiosity, research, question, produce, and are innovative.

When the methods and techniques applied in the approach of STEM education are examined, and the most frequently used method is the project-based learning method. Cepni (2017) highlighted that one of the most common methods used in STEM education is the project-based learning method. This method, created within the framework of John Dewey's views, sees education as life itself and emphasizes that the individual should construct his knowledge. The STEM approach also includes similar approaches. In addition to the project-based learning method, the group work method, research-based learning approach, collaborative learning approach, and 5E learning model are among the methods and techniques applied in the STEM education approach. Bybee (Bybee, 1997) says that when the 5E learning model is used in STEM education, the student can focus on the subject, and explore the information by exploring, organizing, and learning deeply, that is, transfer to situations.

When we look at the origin of STEM, we see that there are real-life problems at the beginning of STEM, and STEM is expressed as the process of perceiving the world. Süldür (2019) also included similar statements on the "Determination of primary school teachers' views on STEM education". One of the main purposes of STEM education is to bring creative solutions to the problems faced by the individual in daily life (Thomasian, 2011).

Teachers who include STEM-based applications in early algebra teaching stated that they benefited from in-service training, STEM field experts, online training, and STEM training given within the university. MoNE (MoNE, 2016) STEM Action Plan includes in-service training activities for teachers to have a positive attitude toward STEM education and to have knowledge and skills on this subject. In this field, studies have been carried out by universities, private institutions, and R&D units of the Directorate of National Education (Aydeniz, 2017).

Teachers who carry out STEM-based activities mostly include studies on the disciplines of Science and Mathematics in their activities. In technology-based applications, studies in the field of robotic coding are used in STEM-based activities. Üçgül (2013) states that robot education applications will be implemented effectively in STEM education. Students working with robots work in integration with the STEM discipline, focusing on solving real-life problems. Barak & Assal (2018) explored that robots can be used with high motivation in interesting environments to provide a quality education in the field of STEM.

4.2. Discussion and Conclusion on the Second Sub-Research Question

In this part of the study, the results obtained by discussing the findings obtained from the opinions of the teachers by asking "the opinions of the primary teachers who carry out STEM-based practices in early algebra teaching on the content knowledge on early algebra" are included. According to the findings for the second sub-problem: all of the teachers see algebra as placeholders used instead of unknowns. According to Turgut (2016), algebra is the

letter or various symbols used in place of unknowns in mathematics in the most general and simplest sense. In other words, it is putting forward an equation regarding the solution of the unknowns based on the knowns. The teachers involved in the research expressed algebra as patterns, symbols, geometry, formulas, equal signs, numbers, spatial relations, shapes, and length measures in the discipline of mathematics. According to Usiskin (1997), algebra is expressed as a mathematical language consisting of five components. These components are "unknowns, formulas, patterns, placeholders, and relations". Algebra focuses on the symbolic side of arithmetic, functions represented by symbols, and solving algebraic equations (Tabach & Friedlander, 2008). Sometimes it is perceived as a symbolic language and sometimes as a learning area within the curriculum.

Krieran (1991) describes early algebra as the transitional process between arithmetic and algebra. This period is also called the pre-algebraic period (Kieran & Chalouh, 1993). The teachers who participated in the research included the expressions of the early period and bonding while defining early algebra. In this context, early algebra acts as a bridge between algebra and arithmetic.

While the majority of the teachers participating in the research indicated the age and grade level at which children will be taught algebra, they expressed the age of 4 as the pre-school period and primary school 1st-grade level. One of the teachers highlighted that the preschool and 1st-grade levels are not suitable for learning algebra early and that algebra will be taught from the 4th grade because algebraic expressions will be more abstract, and the 4-7 age period is not yet ready for abstract thinking skills. In the Mathematics Curriculum published by the Ministry of National Education in 2015, as of the 2016-2017 academic year, there are sub-learning areas for the transition to algebra gradually starting from the 1st, 2nd, 3rd, and 4th grades of primary school. The aim is not to start algebra subjects, but only to contribute to the development of algebraic thinking in preparation for algebra subjects taught in upper grades (MoNE, 2015). Cia and Kunth (2005) argue that expressions of early algebra begin earlier than in middle school and high school. According to NCTM (2000), algebra teaching should be started earlier. Turgut (2016), at the 3rd and 5th-grade levels, students can be given general expressions by using boxes, letters, and symbols.

Early algebra NCTM (2000) defines it as recognizing patterns and relationships, understanding functions, using algebraic symbols, being able to show numerical relationships, using models, and analyzing the change in different situations. Participants in the research stated that early algebra should be taught with the subjects of patterns, spatial relations, geometric shapes, and numbers. In the 2015 Mathematics Curriculum of the MoNE, algebra teaching included concepts such as pattern, variable, and generalization.

Early algebra teaching can be started with the subject areas of patterns, spatial relations, geometric shapes, and numbers. According to Smith (2003), the concept of pattern forms the basis of relativistic thinking. Usiskin (1997) expressed algebra as a mathematical language and divided it into five elements. These five elements are "unknowns, formulas, patterns, placeholders, and relationships." NCTM (2000) highlighted that all of the concepts in algebra will be related to the generalization of patterns and relations between patterns and that this will form the essence of mathematics. Geometric shapes, on the other hand, are not specified as a subject area, but as expressions to be used instead of letters or symbols in displaying variables (Dede & Argün, 2003).

Teachers about the necessary conditions for performing STEM-based activities in early algebra teaching indicated that the classrooms must not be physically crowded, that the classroom layout is appropriate, that the infrastructure and technological equipment are sufficient, that a sufficient budget is provided, and that there is no shortage of materials. Sinan and Terzi (2021) found similar results in their study titled "The Opinions of STEM-Educated Teachers on STEM Teaching".

4.3. Discussion and Conclusion on the Third Sub-Research Question

In this part of the study, the results obtained by discussing the findings obtained from the views of the teachers by asking "the opinions of the primary teachers who carry out STEM-based practices in early algebra teaching on the integration of STEM education approach to early algebra" are included. According to the findings for the third sub-problem: all of the teachers stated that STEM-based applications can be included in early algebra teaching. While Morrison (2019) argues that in the approach of STEM education, the fields of Science, Technology, Engineering, and Mathematics should be integrated with one-to-one, Corlu et al. (2014) argues that at least two of these four disciplines can be carried out in an integrated manner. Early algebra is a learning area within the discipline of mathematics. Therefore, STEM is based on the discipline of mathematics and includes algebra in mathematics. Therefore, STEM can be integrated into early algebra.

In early algebra teaching, teachers carried out STEM-integrated activities in the subject areas of geometric shapes and objects, patterns, weighing, spatial relations, and measuring time. They noted that they used many methods and techniques, especially project-based learning methods, problem-based learning methods, inquiry-based teaching methods, and drama methods, to carry out these activities successfully. Sandal et al. (2018) explored that it would be necessary to use project-based and problem-based methods in classrooms where STEM education is applied. Kaleci and Çınar (2020), on the other hand, discussed that while carrying out STEM-based applications, most of them use cooperative learning and problem-based learning methods.

For STEM integration, STEM practitioners must offer different perspectives. In the integration process of the STEM education approach, approaches, and models such as project-based learning, problem-based learning, design-based learning, mastery learning, context-based learning, and the 5E learning model are used (National Research Council, 2014). Bybee (1997) noted that the use of the 5E learning model in STEM-based activities is beneficial for the student to understand the subject, discover the information, learn by researching and learning in-depth, and adapt the learned information to new situations.

4.4. Discussion and Conclusion on the Fourth Sub-Research Question

In this part of the study, the results obtained by discussing the findings obtained from the views of the teachers by asking "the opinions of the primary teachers who carry out STEM-based applications in early algebra teaching on the applicability of the STEM education approach in early algebra teaching" are included. According to the findings obtained for the fourth sub-problem: participant teachers find the applicability of the STEM education approach in early algebra teaching insufficient and difficult. Among the reasons for this are the reasons arising from the education system, the reasons arising from the knowledge and skills dimension, and the reasons arising from the attitude dimension. Some reasons such as the fact that the curriculum is too dense, especially in the 4th grade, and that the literacy process takes a long time in the 1st grade have been put forward due to the reasons included in the education dimension. In addition, the large size of the class causes the number of groups to increase in the studies to be carried out, and thus, the lack of suitable physical conditions. In addition, the place gains in the program do not exactly match the STEM-based activities to be implemented. It is possible to come across similar findings in different studies (Çiftçi & Çınar, 2017; Eroğlu & Bektaş, 2016).

The teachers who will carry out STEM-based activities do not receive adequate training in this field from the right people. Therefore, since the competencies of the teachers in this area are not at the desired level, problems arise in the application dimension. The teachers involved in the research stated that the students and parents did not have knowledge about the practices or they had the wrong information.

Participating teachers who carried out STEM-based activities indicated that their work was not supported by other teachers, and they even had negative attitudes about it. The feasibility of conducting such studies is low because school administrators do not provide the necessary convenience to teachers and exhibit negative attitudes. In addition, participant teachers stated that parents focus on academic success and do not support such activities, and exhibit negative attitudes. Within the framework of all these, it is concluded that the

implementation of the STEM education approach in early algebra teaching is not at the desired level and is insufficient.

Teachers about the necessary conditions for performing STEM-based activities in early algebra teaching noted that the classrooms must not be physically crowded, that the classroom layout is appropriate, that the infrastructure and technological equipment are sufficient, that a sufficient budget is provided, and that there is no shortage of materials. Sinan and Terzi (2021) found similar results in their study titled "The Opinions of STEM-Educated Teachers on STEM Teaching".

Parents, school administration, and other teachers should approach the studies positively and constructively. At the same time, teachers should be highly motivated and open to innovation. Parents and students should have prior knowledge about these applications and students should come to the classes by doing research. In addition, they expressed their opinions about the simplicity of the curriculum and the reduction of the subjects, especially at the 4th-grade level.

4.5. Discussion and Conclusion on the Fifth Sub-Research Question

In this part of the study, the results were obtained by discussing the findings obtained from the opinions of the teachers by asking "the positive aspects and suggestions of the primary teachers who carry out STEM-based practices in early algebra teaching, of including STEM-based activities in early algebra teaching" are included. According to the findings obtained for the fifth sub-problem: including STEM-based activities in early algebra teaching causes the student to have a positive attitude towards mathematics lessons. These applications facilitate learning and offer fun learning environments. Teachers see mathematics as an abstract field and state that such practices embody the concepts of mathematics. Therefore, it reduced the anxiety of the students towards the mathematics lesson and provided effective and permanent learning, and as a result, the academic success of the student increased. It contributes positively to the career choice of students in the future. Çepni (2017) noted that STEM education contributes to the development of high-level skills such as 21st-century skills individuals. These skills appear in international assessment exams, in choosing a profession, and in many other branches. Integration of STEM into the curriculum is also extremely important in gaining 21st-century skills.

The teachers who participated in the study noted that they had the most material shortage while carrying out STEM-based activities in early algebra teaching. The overcrowded class size, the dense curriculum, and the insufficient technological infrastructure are among the difficulties faced by teachers while performing these practices. In addition, negative attitudes of schools, parents, and other teachers are among the problems that

teachers face in practice. STEM requires cooperation between stakeholders in school culture (Basham et al., 2010). In STEM school culture, there should be a continuous exchange of knowledge and experience between administrators and teachers. In the study conducted by Park et al. (2017), the lack of materials, lack of time, lack of professional development, lack of parent participation, and negative attitudes of teachers in the implementation of STEM-based activities were indicated.

The teachers involved in this study made the following suggestions to teachers and administrators for the realization of such practices to support their personal development, the teachers suggested that they scan the sources, read articles and magazines by doing research, review the video content on this subject, and be innovative and creative individuals.

Participating teachers stated that to contribute to the professional development of teachers and administrators, they should attend in-service training and receive training from experts in their fields. Teachers need to receive STEM education. Teachers should be trained to gain knowledge, skills, and experience in line with the importance of STEM education (Wang et al., 2011). After this training, teachers can practice in their classrooms and even plan extracurricular exercises.

Ethical Declaration

In this study, all scientific ethical rules were followed.

Conflict Interest and Author Contributions

All stages of study were organized and conducted by Author. There is no conflict to interest.

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