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Journal of Qualitative Research in Education
Eğitimde Nitel Araştırmalar Dergisi

The Use of Augmented Reality, Virtual Reality and Mixed Reality Technologies in Education: A Bibliometric and Systematic Review

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Abstract: This study aims to conduct a bibliometric analysis of the articles published on Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR) research in the field of education. This study also aims to provide more comprehensive information on research trends by conducting a systematic review based on bibliometric analysis data. Therefore, this study was designed according to the multiple research methods. In this direction, bibliometric analysis was conducted first. After the bibliometric analysis, the systematic review technique was used to evaluate the most cited studies. VOSviewer was used to analyze bibliometric data, and the MaxQda program was used to analyze systematic review data. In this study, the findings showed that educational research conducted with AR and VR started to be conducted in the 1990s. On the other hand, it was determined that the integration of MR research into education began in the mid-2000s. The findings showed that the keywords virtual reality, augmented reality, education, medical education, simulation, and mixed reality, respectively, were used more in the studies found in Web of Science. Also, it was observed that research on AR, VR, and MR was mostly conducted in the United States of America and China. On the other hand, it was concluded that the studies were published more in "Education and Information Technology" and "Interactive Learning Environment" journals. Three publications by Guido Makransky ranked in the top ten regarding the number of citations. Similarly, Makransky ranked first among the authors who published the most articles. Finally, it was observed that the studies conducted with these technologies were mostly written by two, three, and four authors.

Keywords: Augmented reality, Virtual reality, Mixed reality, Education Technologies, Bibliometric analysis, Systematic review.

About the Article

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Introduction

Technological developments in recent years have led to the emergence of many innovative instructional technologies in the field of education. In this context, the potential effects of many technological systems, such as AR, VR, and MR, on education are being investigated. For this reason, there are many studies in which related technologies are applied experimentally in schools, although not as much as classical education and teaching methods (Beyoglu vd., 2020; Córcoles-Charcos vd., 2023; Marrahi-Gomez & Belda-Medina, 2024).

These technologies are based on the use of virtual data to change the physical world around the user (Lungu et al., 2020). Milgram and Kishino (1994) introduced the idea of a virtual continuum and explained the definitions of these technologies and their relationships with each other. Researchers have also depicted the virtual and real worlds as two ends of a line and defined the environments between these two worlds as MR. In other words, in MR, virtual and real spaces are spatially merged (Holz et al., 2011). In this context, it can be said that MR is a combination of both VR and AR.

On the other hand, VR technology, or virtual environment, puts users in a completely artificial world without seeing the real world (Carmigniani et al., 2011). So, the VR environment can be used to visualize a completely imaginary world (Christou, 2010). Furthermore, VR is also defined as visualizing computer graphics systems using various devices (Pan et al., 2006). In other words, VR allows users to interact with a computer-generated 3D model or virtual environment. This environment can be realistic on a macroscopic scale, or it can depict the physical world known to science but unobservable.

In contrast to VR, AR refers to a 2D or 3D virtual interface that enhances reality by embedding digital elements into the existing world. Thus, AR technology does not involve a completely virtual world (Elmqaddem, 2019). That is, AR involves overlaying computer-generated images onto the real environment (Speicher et al., 2019; Tepper et al., 2017). However, to experience the AR in real-time, a trigger is required (Maas & Hughes, 2020). Accordingly, AR technologies are mainly classified as marker-based, non-marker-based, and location-based (Burtchart, 2011). Additionally, the fact that there is no need to use intensive software to make 3D designs is another feature that distinguishes AR from VR. (Striuk et al., 2018). In addition to these differences, it is thought that there may be similarities between these technologies as a whole. This necessitates a bibliometric mapping analysis of the relevant technologies.

When the literature was examined, it was seen that many bibliometric analysis studies were conducted separately on AR, VR, and MR technologies in the field of education (Arici et al., 2019; Hincapie et al., 2021; Liu et al., 2017; Mani & Madhusudan, 2022; Rojas-Sánchez et al., 2023; Soto et al., 2020; Talan, 2021). Similarly, there are educational studies in the literature that deal with the technologies above in pairs and perform them within the scope of bibliometric analysis (Calabuig-Moreno et al., 2020; Zhao et al. 2023). However, not addressing AR, VR, and MR technologies holistically

limits the opportunity to create pedagogy (Maas & Hughes, 2020). Therefore, Zhang et al. (2022) conducted a bibliometric analysis including all three technologies. Nevertheless, in this study, only surgical studies were focused on, and other fields were ignored. Therefore, three technologies were evaluated together in this research to increase the scope of information on educational technologies. It is thought that this situation will make a significant contribution to researchers, policymakers, and teachers who examine AR, VR, and MR practices in education. It is also envisaged that this study will be a valuable resource for researchers. In line with the stated reasons, the study aims to conduct a bibliometric analysis of articles published on AR, VR, and MR research in the field of education. In addition, this study aims to provide more comprehensive information on research trends by conducting a systematic review based on bibliometric analysis data.

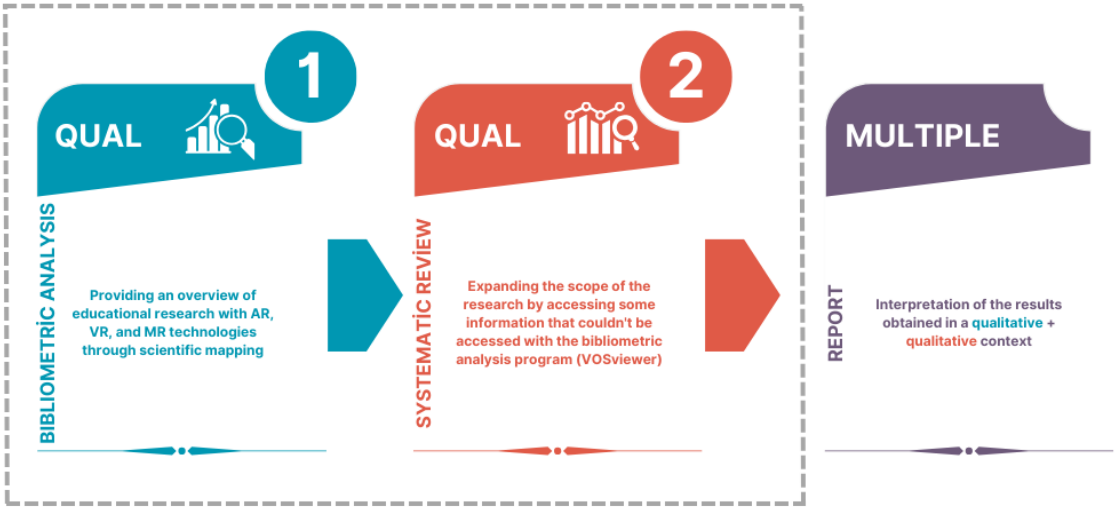
Method

Research Design

This study was designed using multiple research methods. Multiple research methods can be defined as using two or more data collection methods together to examine the research problem (Cohen et al., 2007). In the present research, this method was chosen to check the integrity of the conclusions or to increase the scope of information systematically (Christensen et al., 2014). In this direction, two different qualitative methods were utilized in this study, and bibliometric analysis was conducted first. Bibliometric analysis can be explained as a mapping technique that enables and empowers researchers to obtain an overview of the subject, identify gaps in the literature, and access new information by making large volumes of unstructured data meaningful. (Donthu et al., 2021). After the bibliometric analysis, the systematic review technique was used to evaluate the most cited studies. This technique is used to identify studies on the research topic, to assess critically, and to systematically analyze them (Moher et al., 2010). The scheme created for multiple research methods and the stages to be realized in this context are shown in Figure 1. In Figure 1, the bibliometric analysis process is symbolized in blue "■," the systematic review process in orange "■," and the progression between the stages is symbolized by the arrow "→".

Figure 1.

Stages Followed in the Research According to Multiple Research Methods

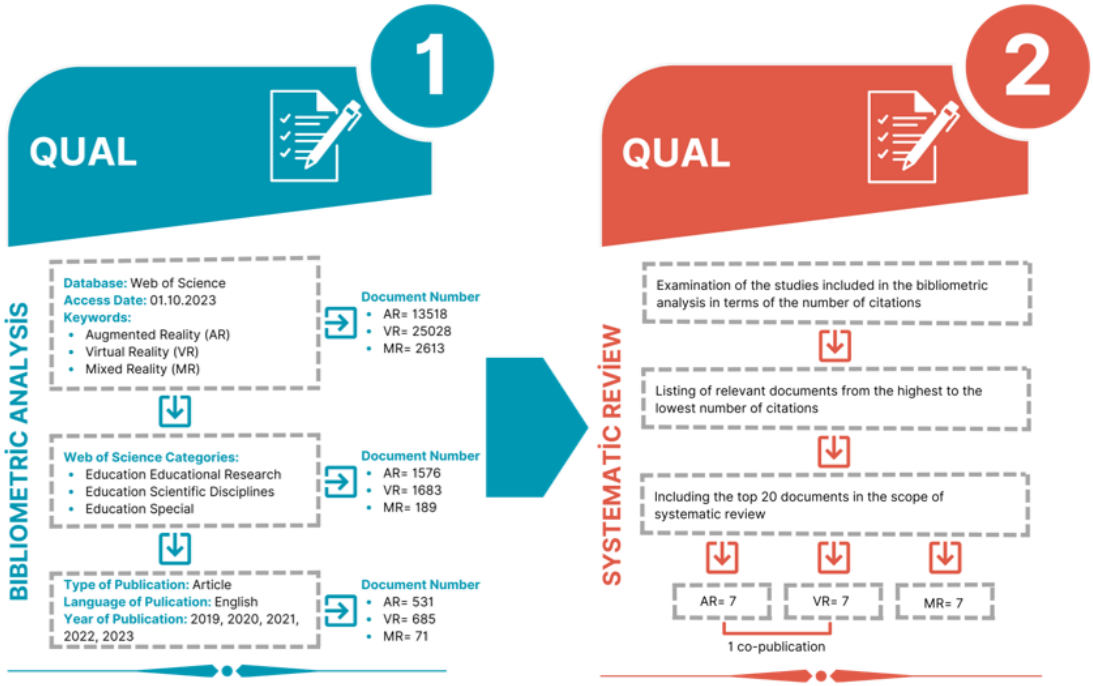


Data Collection Process

The data collection process in this study was carried out in two stages within the scope of multiple research methods. The first stage included the bibliometric analysis process to determine the general trends of educational research on AR, VR, and MR. The second stage involved a systematic review to expand the scope of this research by accessing some information that could not be reached with the bibliometric analysis program. This data collection process is shown in Figure 2 and explained in detail.

Figure 2.

Data Collection Process

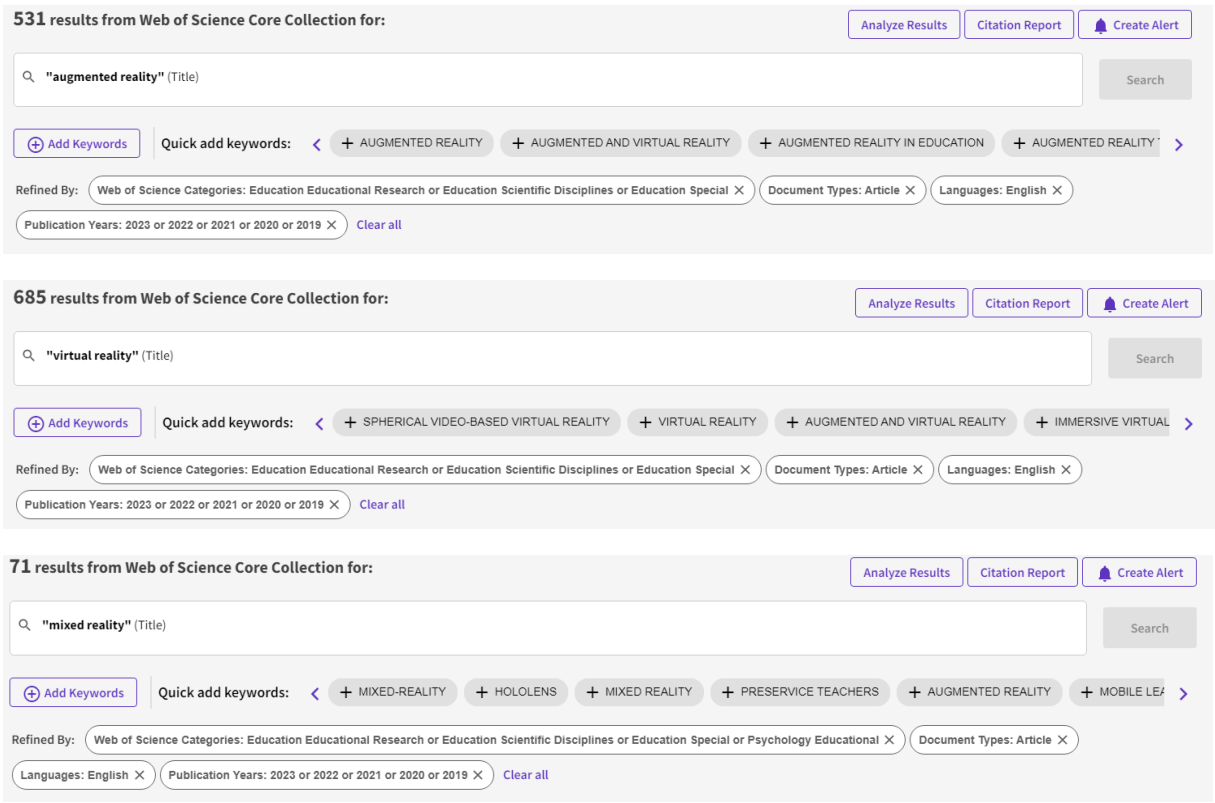


Selection of Documents Included in Bibliometric Analysis

In the present research, the keywords "augmented reality," "virtual reality" and "mixed reality" were used for scanning. A search was conducted on the Web of Science database on 01.10.2023, considering the title category according to the relevant keywords. In this context, 13518 studies for AR, 25028 studies for VR, and 2613 studies for MR were reached. Then, education as the field, articles as the type of publication, English as the language, and the last five years as the date were taken as criteria. Thus, the number of studies was limited, and 1287 studies on AR (n=531), VR (n=685), and MR (n=71) were downloaded in .txt format. Screenshots of the scans made in line with these criteria are presented in Figure 3.

Figure 3.

Screenshots of the Scans

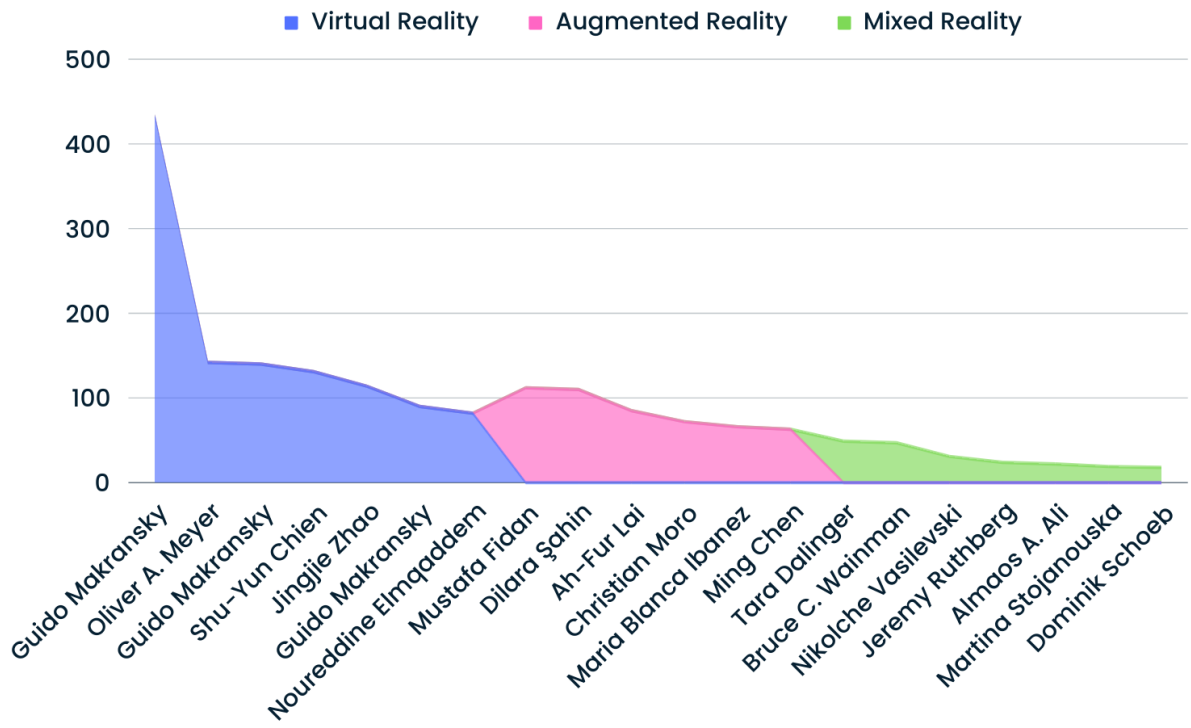


Selection of Documents Included in Systematic Review

The number of citations was taken into consideration in the selection of the articles included in the systematic review because it was thought that studies with a high number of citations contributed more to other studies. Therefore, due to the bibliometric analysis, the documents were first sorted regarding the number of citations from highest to lowest. Then, they were categorized as AR, VR, and MR. In this direction, seven articles from each technology according to the number of citations were transferred to the systematic review process. Thus, 21 documents were reviewed. However, since Noureddine Elmqaddem uses both AR and VR technologies, 20 documents in total were systematically evaluated. The publications analyzed are presented in Figure 4, along with their citation ranking.

Figure 4.

Studies Included in the Systematic Review



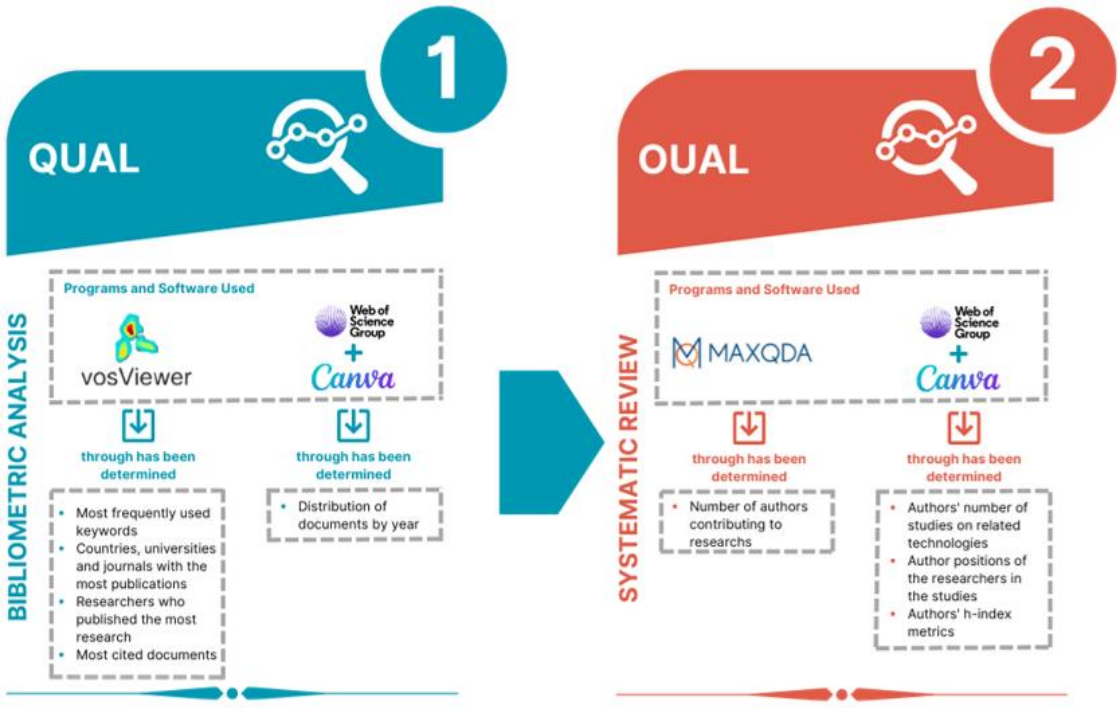
Based on Figure 4, it can be stated that VR studies are cited more than AR and MR studies. In addition, the citations for MR technology are relatively fewer than the others. When the studies were considered in general, it was determined that the number of citations of Guido Makransky was approximately five times more than the second-ranked study (Oliver A. Meyer). On the other hand, it is remarkable that Guido Makransky had three publications in the first 20 documents. Hence, Guido Makransky was evaluated once in the analyses made in terms of the author, and the analyses were made by over 18 researchers.

Data Analysis

The data analysis process in this study was carried out in two stages within the scope of multiple research methods. The first stage involved the analysis of bibliometric data, and the second stage involved the analysis of systematic review data. This analysis process is explained in detail in Figure 5.

Figure 5.

Data Analysis Process



Analysis of Bibliometric Data

The analysis of the documents accessed within the scope of this research was carried out using the VOSviewer program developed by van Eck and Waltman (2010). VOSviewer was chosen for its high ease of use, user flexibility, and capability to export electronic maps (Arruda et al., 2022). Other advantages of VOSviewer are the lack of programming knowledge and the zoom and pan options to facilitate detailed examination of the maps created (Moral-Muñoz et al., 2020). In this study, the most frequently used keywords in the relevant documents were identified through VOSviewer; the countries, universities, and journals with the highest number of publications were revealed. In addition, the researchers who published the most research and the most cited documents were identified using the program. On the other hand, the distribution of relevant documents by year was analyzed through the Web of Science database, and a holistic graph of the years was created with Canva software.

Analysis of Systematic Review Data

The documents included in the systematic review were transferred to the MaxQda 20 program. In this context, the documents were analyzed in terms of the number of authors. However, since the number of studies of the authors on AR, VR, and MR technologies, the author positions of the researchers in the studies, and the h-index metrics of the authors could not be analyzed with the MaxQda program, other systematic data were

done manually using Web of Science. All data obtained from the systematic review were transformed into figures, and only author names and frequency information were presented in these figures.

Findings

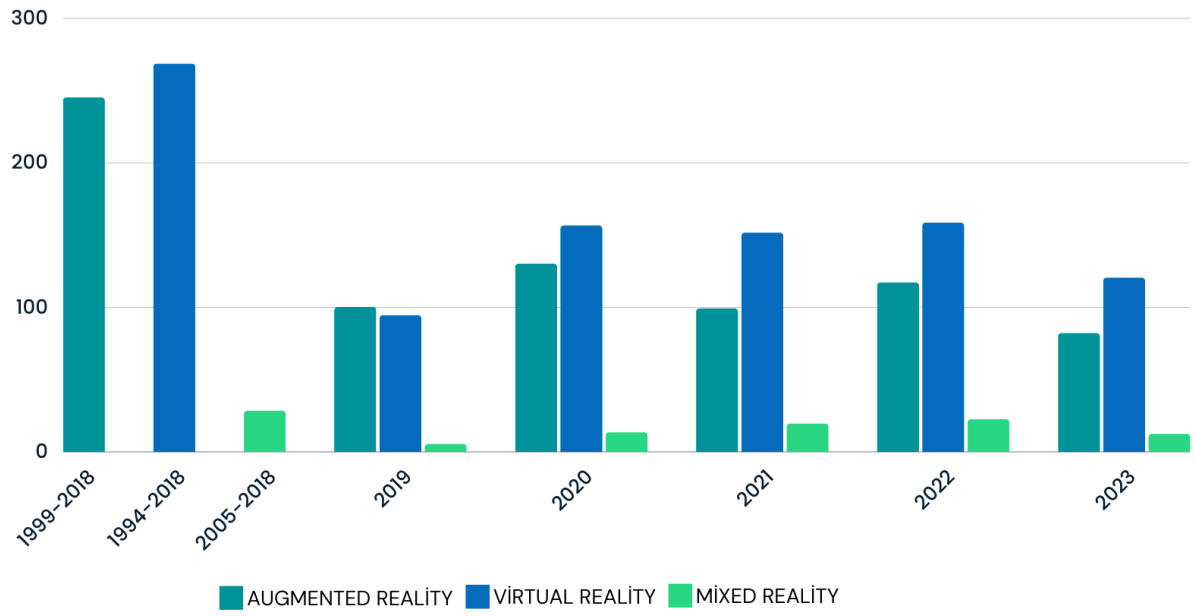
Findings from Bibliometric Analysis

Distribution of Research by Year

A total of 1819 articles in the field of education with AR, VR, and MR technologies indexed in the Web of Science database were reached. Of the related studies, 947 were related to VR, 773 to AR, and 99 to MR technologies. In this context, studies were presented as 2019 and later, and all studies before this date are shown together. The distribution of studies by year is visualized in Figure 6.

Figure 6.

Distribution of Studies by Year

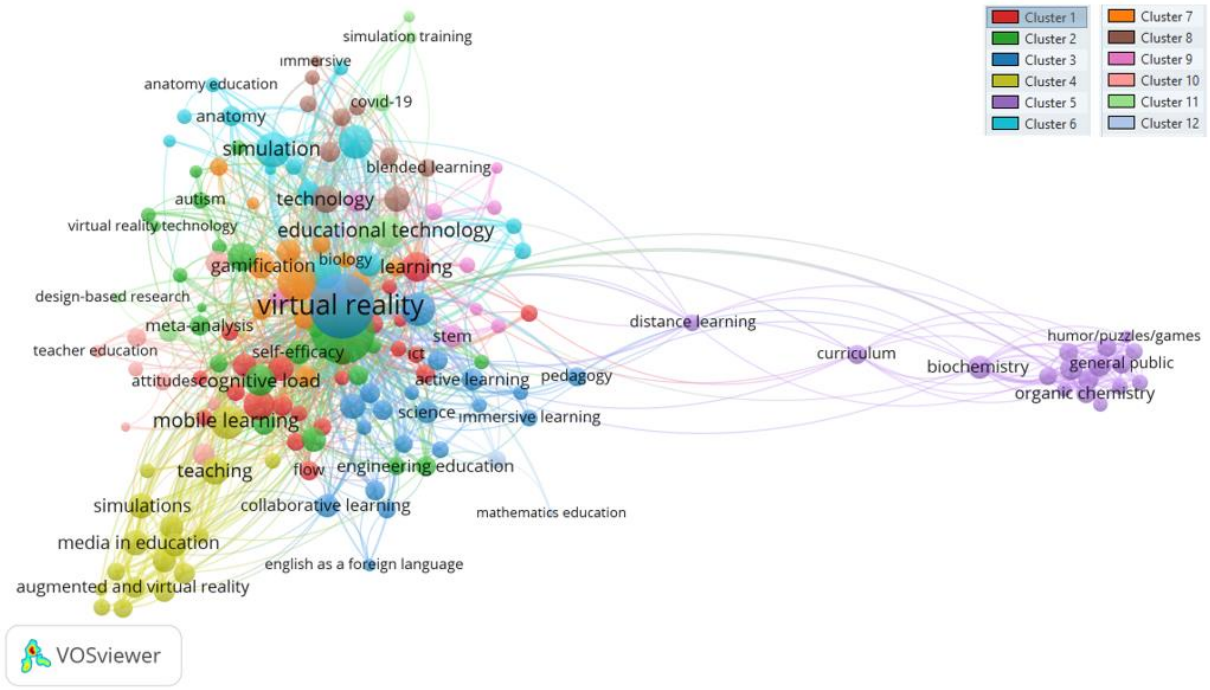


When Figure 6 is analyzed, it can be said that AR research has been conducted since 1999, VR technology was first used in education in 1994, and studies on MR technology started in 2005. However, it can be stated that educational research in related fields has increased in the last five years. In this context, it was determined that the number of studies published in 2019 and later is higher than all the studies published before this date. In addition, Figure 6 shows that the number of studies integrating VR with education is higher than other reality technologies.

Keywords Most Frequently Used in Studies

Cooccurrence (author keywords) analysis was performed to determine the keywords used in the studies performed with AR, VR, and MR. It was determined that the studies included in the analysis contained 2978 keywords. However, in this study, the minimum number of repetitions of keywords was set to 5 to make the map generated by the program more understandable. Thus, it was seen that only 161 keywords met the specified criteria. Link strength was calculated for each of these words, and the map of the words with the highest link strength is presented in Figure 7.

Figure 7.
Keywords Most Frequently Used in Studies



As shown in Figure 7, it was determined that the keywords used in the studies on AR, VR, and MR technologies consisted of 12 clusters. Different colors were used to represent the relevant clusters. It was also found that keywords, such as virtual reality (n=458), augmented reality (n=389), education (n=60), medical education (n=53), simulation (n=49), mixed reality (n=38), mobile learning (n=36), educational technology (n=32) and computer-based learning (n=30), were frequently preferred in the documents included in the present study. Furthermore, in the related studies, it is generally observed that AR, VR, and MR have a strong connection with the words self-efficacy, language learning, teachers, usability, online learning, music education, education, training, educational technology, and higher education. On the other hand, it can be stated that the links of keywords with words, such as computer-based learning, organic chemistry, English as a foreign language, biochemistry, curriculum, distance learning, media in education, simulation, simulation training, anatomy, anatomy education, immerse,

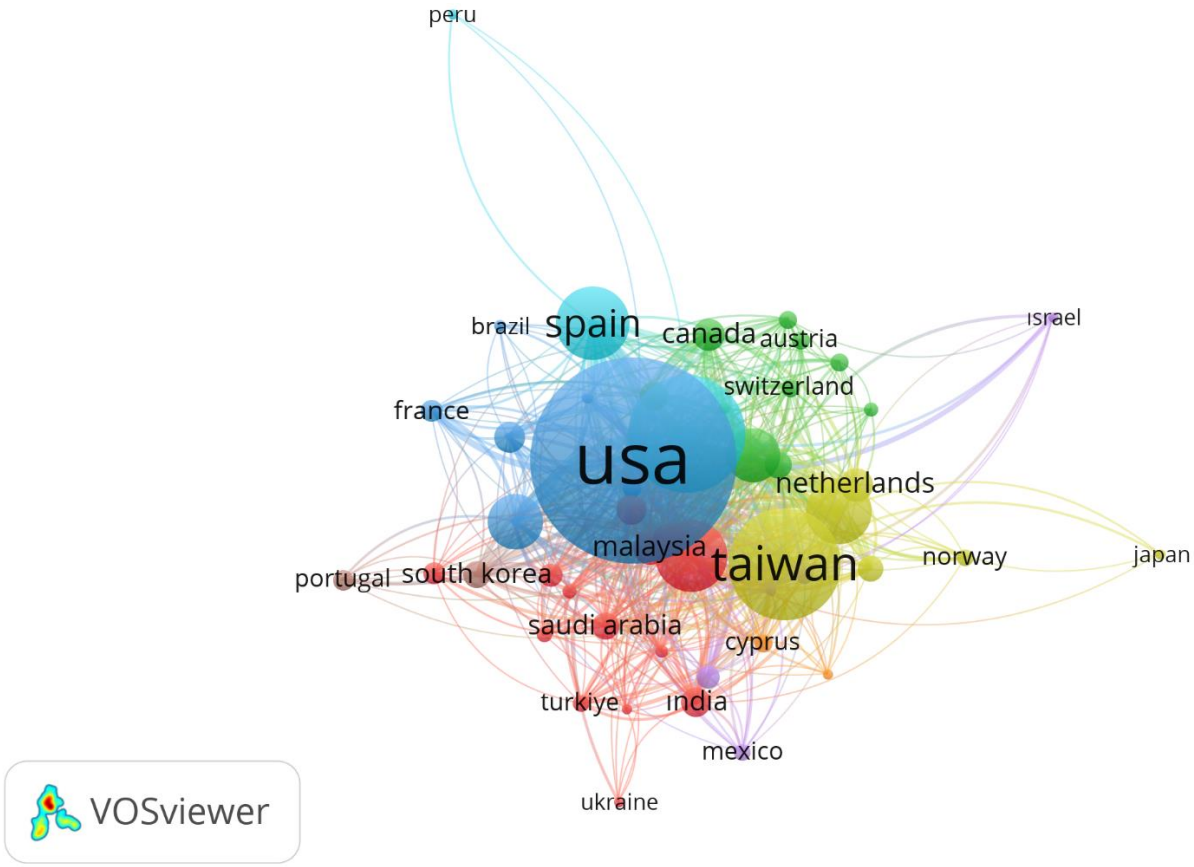
COVID-19, surgical training, and dental education, are weak. Therefore, it can be said that AR, VR and MR studies are less preferred than others in health education.

Countries with the Most Publications

Educational studies supported with AR, VR, and MR technologies were analyzed in the context of countries. For this purpose, citation (country) analysis was performed, and at least five publications were accepted as criteria. Accordingly, only 49 out of 88 countries were included in the analysis. The countries with the highest number of publications are given in Figure 8.

Figure 8.

Countries with the Most Publications



According to Figure 8, it can be stated that most AR, VR, and MR research is conducted in the United States of America (n=296). Following the United States, China (n=144), Taiwan (n=136), and Spain (n=79) were found to integrate these technologies more in educational research. In addition, the studies conducted in Taiwan and China were shown separately. However, since the official name of Taiwan is China, the researchers took the initiative to combine these data (n=280). Thus, it can be said that the number of studies conducted in China is getting closer to the number of studies conducted in the United States. Moreover, both Turkey (n=78) and Turkiye (n=12) were used separately

in the related studies. Therefore, these technologies have been used in educational research in Turkey a total of ninety times. Thus, the ranking of the countries where AR, VR, and MR technologies are most frequently used has changed, and Turkey, which was ranked fifth, has risen to third place, above Spain. On the other hand, while there were almost no studies on educational technologies in Africa, this situation is more evenly distributed in Europe. The distribution of countries' research on AR, VR, and MR is shown in Figure 9.

Figure 9.

Distribution of Research by Country

Universities with the Most Publications

The studies in which AR, VR, and MR were used were reviewed regarding universities. In this context, firstly, an analysis was made in the citation (organizations) section by considering five publication criteria. Therefore, only 84 out of 1421 universities were included in the analysis. The universities with the highest number of publications are given in Table 1.

Table 1.

Universities with the Highest Number of Publications

University	Country	Number of Publication	Number of Citation
National Taiwan Normal University	China	35	668
National Taiwan University of Science and Technology	China	25	428
University of Copenhagen	Denmark	17	1043
The Chinese University of Hong Kong	China	17	451
Beijing Normal University	China	13	162
Nanyang Technological University	Singapore	13	111
National University of Singapore	Singapore	12	114
Comenius University Bratislava	Slovakia	12	67
Chıtkara Unıversıty	India	11	125
National Changhua University of Education	China	10	86
National Yunlin University of Science and Technology	China	10	134
Bond University	Australia	10	144
University of North Texas	USA	10	104
University of North Carolina	USA	10	159

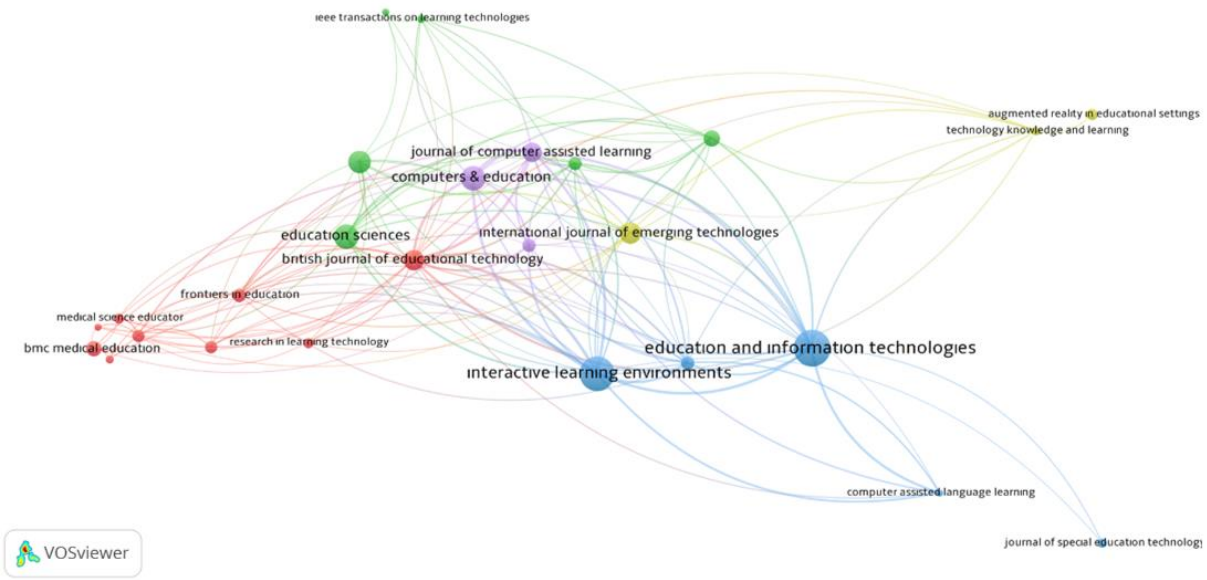
As shown in Table 1, it was seen that "National Taiwan Normal University" was the university that conducts the most research on AR, VR, and MR technologies. "National Taiwan University of Science and Technology" is followed by "National Taiwan Normal University" regarding the number of publications. In this context, it is noteworthy that the top two places are held by universities in China and that there are four different Chinese universities in the top five. It was also seen that only one European country (Denmark) is in the top five. The majority (n=9) of the universities with the highest number of publications on AR, VR, and MR technologies were from Asian countries. However, Figure 8 shows that the United States of America ranked first. Similarly, although Turkey ranked third among countries in terms of publications, it did not make it into the top fourteen at the university level. On the other hand, when the universities in Table 1 were compared according to the number of publications and citations, it was determined that "University of Copenhagen" in the third place (17 articles) received more citations (n=1043) than the others. Thus, the average number of citations for each publication at the mentioned university was 61, which can be considered a high level.

Journals with the Most Publications

Educational research studies in which AR, VR, and MR technologies were used were reviewed in terms of the journals in which they were published. In this direction, citation (sources) analysis type was used. In addition, the minimum number of publications was taken as 10, and journals with publications below this limit were excluded. Thus, 27 out of 281 journals were included in the analysis. The journals that published the most research among the relevant journals are given in Figure 10.

Figure 10.

Journals with the Most Publications



Considering Figure 10, it can be said that AR, VR, and MR studies, respectively, were published in "Education and Information Technology" and "Interactive Learning Environment" journals. Following these journals, it can be stated that "Education Sciences," "Computers and Education" and "Journal of Chemical Education" journals had more educational research on related technologies. When these journals were analyzed in terms of the index and impact factor, it was found that "Education and Information Technology" (Q1, JIF =5,3), "Interactive Learning Environment" (Q1, JIF=5,4), and "Computers and Education" (Q1, JIF=12,6) were indexed in SSCI. In addition, "Education Sciences" is indexed in ESCI (Q1, JIF=2,8), and "Journal of Chemical Education" is indexed in SCI-E (Q2, JIF=2,8). Moreover, when analyzed regarding the number of publications, it can be stated that the journals in the top ten were generally technology-oriented (n=8). On the other hand, when the journals in the figure are compared, it was seen that "Computers and Education" received more citations (n=1986) than the others despite having 51 articles.

Authors with the Most Publications

Citation (authors) analysis was conducted to determine the authors of the studies on AR, VR, and MR. It was determined that the studies included in the analysis included 4103 authors. However, in this study, the minimum number of repetitions of the number of documents belonging to the authors was set to three to make the map created by the program more understandable. Thus, it was seen that only 135 authors met the specified criteria. Link strength was calculated for each of these authors, and the map of the authors with the highest link strength is presented in Figure 11.

Figure 11.

Authors with the Most Publications

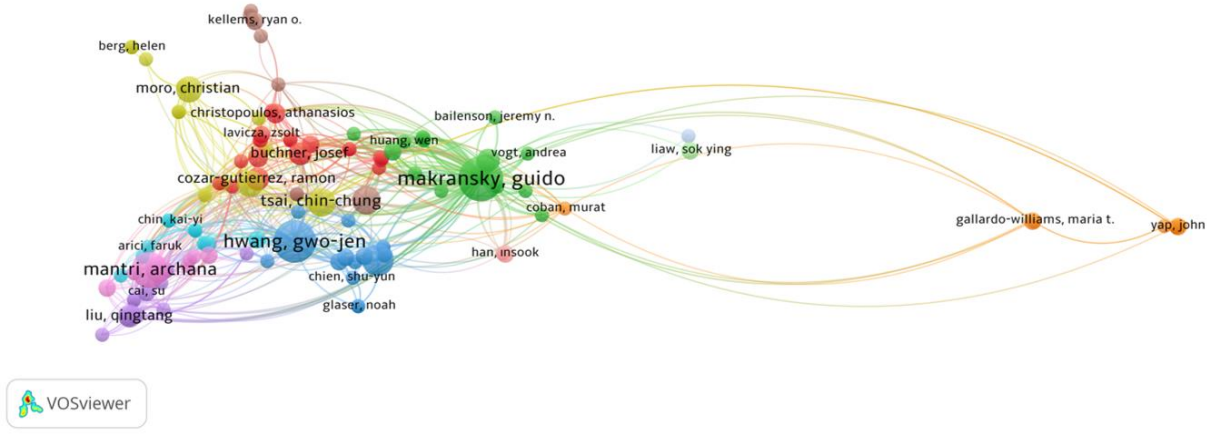


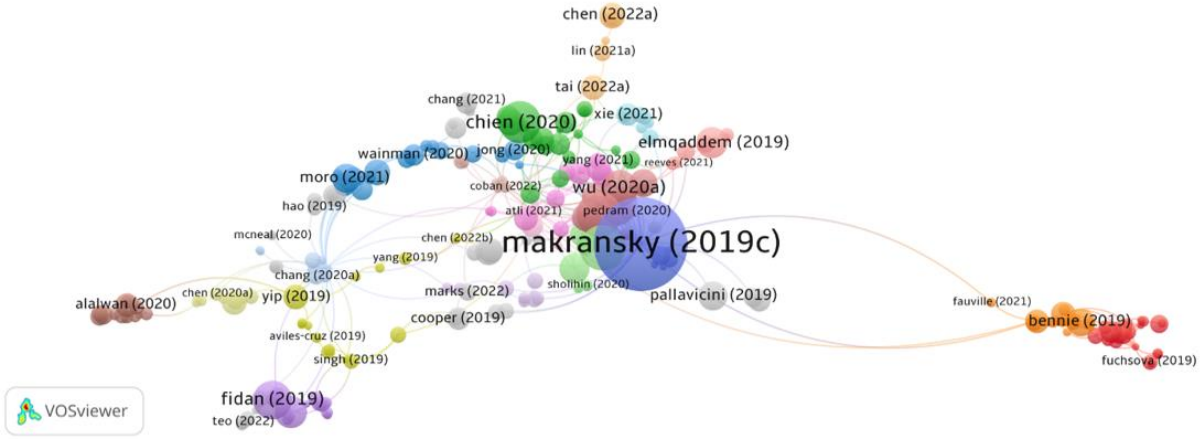
Figure 11 shows that Guido Makransky (n=15), Gwo-Jen Hwang (n=14), and Archana Mantri (n=11) were the authors who published the most articles. Similarly, Makransky also ranked first in terms of citations. However, it is remarkable that Richard Meyer received a high number of citations (n=728) despite having five publications. Accordingly, it can be said that Meyer's average number of citations per article was 146. In addition, the presence of Turkish researchers (n=7) in the author list created by the program is important regarding the position and future of technology in the Turkish education system.

Most Cited Articles

Educational studies supported with AR, VR, and MR technologies were analyzed in terms of citations. For this, citation (document) analysis was performed, and at least 10 citations were accepted as a criterion. Accordingly, only 399 out of 1262 studies were included in the analysis. The most cited articles are presented in Figure 12.

Figure 12.

Most Cited Articles



Considering Figure 12, it was determined that three publications by Makransky ranked in the top ten in terms of the number of citations. It was observed that the researcher published these studies in 2019. This may be attributed to the fact that Makransky is the researcher with the highest number of publications on related topics, as indicated in Figure 11. In addition, when the data obtained from Table 1 and Figure 12 are compared, it is found that there are consistent results. In this context, it was determined that the most cited researcher worked at the university with the highest number of citations. From this point of view, it can be claimed that Makransky contributed significantly to the number of citations of the University of Copenhagen (n=1043) with 795 citations, and thus increased the recognition of the university. On the other hand, it is remarkable that there are three articles from Turkey in the top ten and that these studies received 345 citations. According to the results, it is important that this study covers 28% of the total number of citations (n=1232) received by the studies conducted in Turkey.

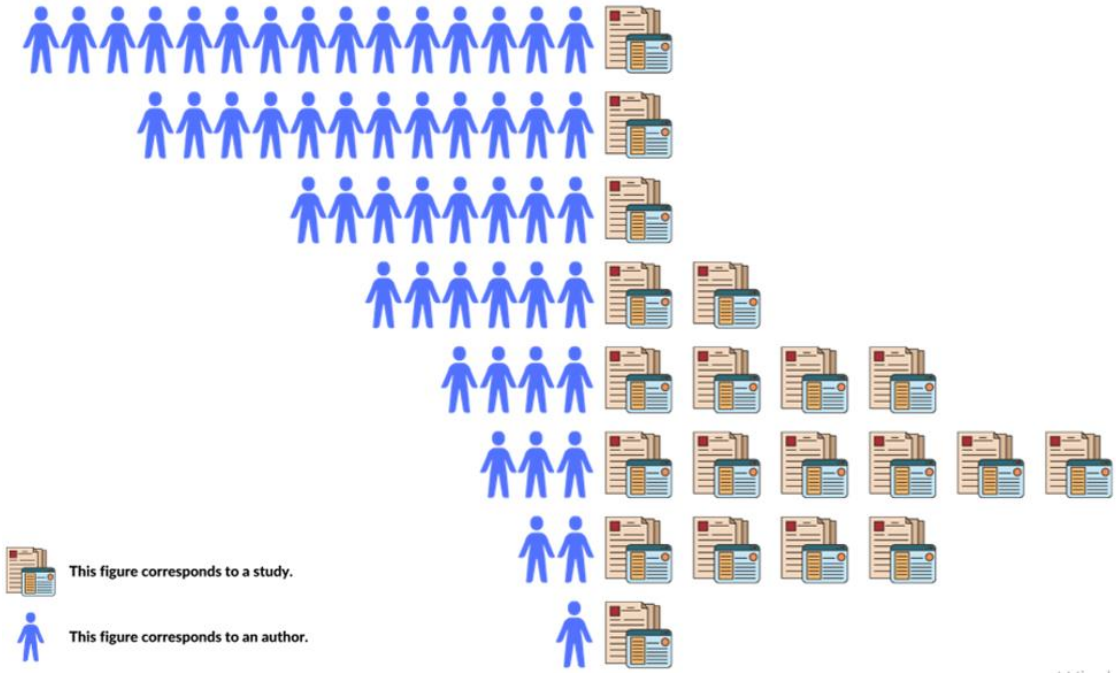
Findings from Systematic Review

Number of Authors Contributing to Research

Systematically analyzed 20 documents were reviewed in terms of the number of authors. Thus, it was tried to make predictions about how many teams of people technological studies can usually be conducted with. In addition, through the findings, suggestions on how to provide an effective and efficient collaboration environment in technological research were presented. The findings obtained in this context are presented in Figure 13.

Figure 13.

Number of Authors Contributing to Research



Considering Figure 13, it can be said that AR, VR, and MR studies are generally conducted with two, three, and four authors. It is also remarkable that studies were conducted with at least six authors. In this context, it can be stated that there were two studies with six authors and one study each with eight, twelve, and fifteen authors. Four of the related studies cover MR, and one of them covered AR. Moreover, some of the related studies resulted from the cooperation of different countries, universities, and departments. On the other hand, it was determined that there was a single-authored study.

Authors' Number of Studies on Related Technologies

It was determined that the 20 studies included in the systematic review were conducted by 90 authors (Figure 13). Due to the large number of authors, only the number of studies on related technologies conducted by the (first) researchers responsible for the studies was analyzed. However, since Makransky was the corresponding author in three studies, he was evaluated once. Thus, the number of studies by 18 authors was reviewed. In this direction, the authors' studies in Web of Science were considered. The distribution of authors according to the number of studies is visualized in Figure 14.

Figure 14.

Distribution of Authors According to the Number of Studies

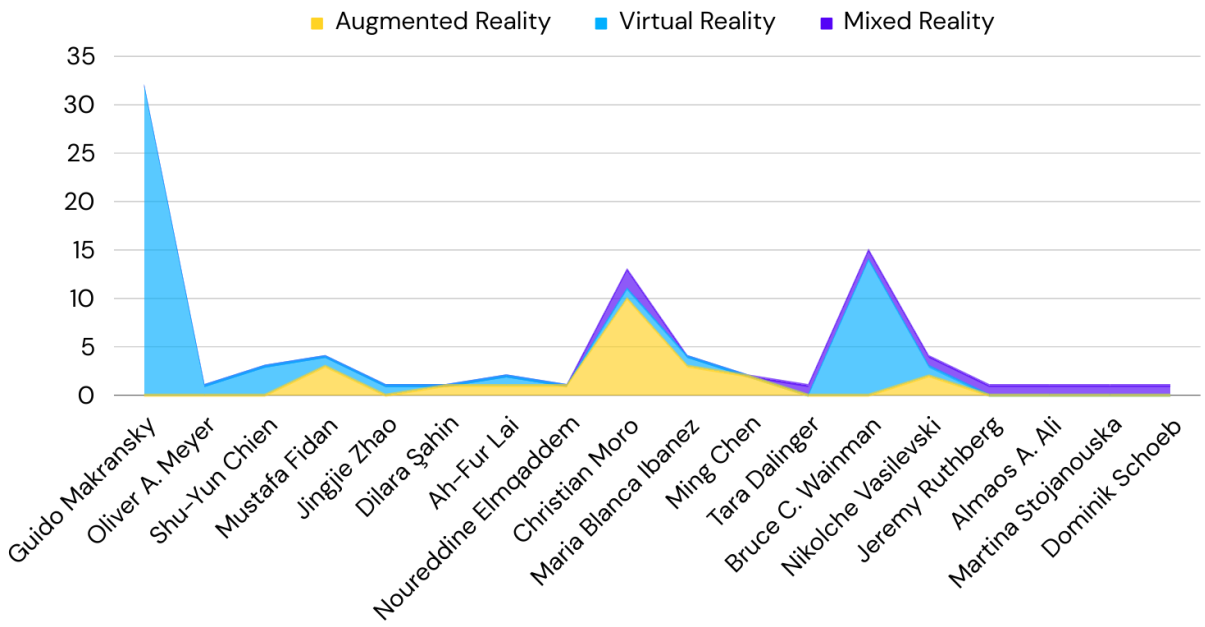


Figure 14 shows that some researchers (Christian Moro, Bruce C. Wainman, and Nikolche Vasilevski) used related technologies together. In this case, the related studies were evaluated within the scope of the technology the author used more in his research. For example, Christian Moro conducted 10 AR, 5 VR, and 2 MR studies. However, four of the VR studies and one of the MR studies were conducted with AR technology. Therefore, since the number of AR studies conducted was higher than the others, four VR and one MR study were presented only as AR studies. In the new situation, it is accepted that Christian Moro conducted 10 AR, one VR, and one MR study. Based on this, when Figure 14 is analyzed, it was seen that the number of studies conducted by Guido Makransky with related technologies in general (n=32) was more in Web of Science. Similarly, Guido Makransky was the author who had published the most articles in the last five years, with 15 studies (Figure 11). Figure 11 also shows that Gwo-Jen Hwang and Archana Mantri were second and third in the ranking of authors who published the most articles with 14, and 11 publications, respectively. However, Figure 14 does not include these authors. Therefore, it can be said that although the relevant authors published many publications in the last five years, these publications were insufficient in receiving citations. However, according to Figure 14, it is remarkable that although nine authors had only one study each with AR, VR, and MR technologies, they were highly cited.

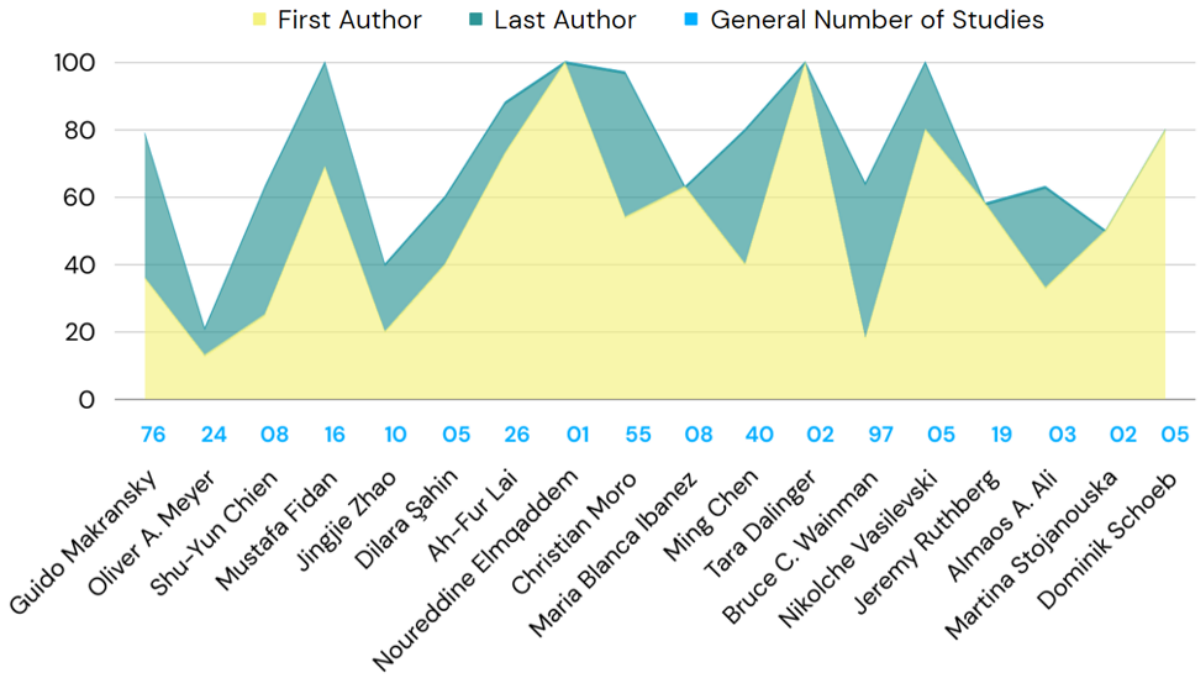
Author Positions of the Researchers in the Studies

Figure 14 shows the number of studies of the authors on the related technologies in the Web of Science database. However, the author's position of these researchers in all the

studies they conducted was also important. Therefore, all studies of 18 researchers indexed in Web of Science were checked for author rankings. Thus, the rates of researchers being the first and last authors in the studies were determined. The findings obtained in this direction are given in Figure 15.

Figure 15.

Author Positions of the Researchers in the Studies



When the author positions of the researchers in the studies were analyzed, it was seen that Noureddine Elmqaddem (100%) and Tara Dallinger (100%) had the highest rate of being the first authors. However, these authors have 1 and 2 articles in Web of Science, respectively (Figure 15). Similarly, the fact that Nikolche Vasilevski and Dominik Schoeb contributed only five articles can be considered the main factor that increased their percentage to 80. Therefore, it is useful to look at how many articles this rate corresponds to in all studies rather than the rate of first authorship. From this point of view, when all studies are multiplied by first-author ratios, it can be said that Christian Moro is the first author with 30 studies. However, it is remarkable that Moro ranked third in terms of the total number of studies. In addition, Guido Makransky stood out as the second researcher with the highest number of first authors, with 27 studies. These researchers were followed by Ah-Fur Lai with 19 studies and Bruce C. Wainman with 17 studies. However, it is remarkable that Wainman had the highest number of publications (n=97) among these researchers. Thus, although Wainman published many studies on the Web of Science, it can be stated that he was the first author in a very small fraction of them.

Authors' h-index Metrics

Figure 12 shows the most cited articles and authors, Figure 11 shows the researchers with the highest number of publications on AR, VR, and MR in the last five years, and Figure 14 shows the number of studies conducted by authors on these technologies in general. However, these are not considered sufficient to demonstrate a researcher's contribution to science. Therefore, the h-indexes in the Web of Science database were checked to determine the scientific impact of the authors included in the systematic review. The findings obtained in this direction are presented in Figure 16.

Figure 16.

Authors' h-index Metrics

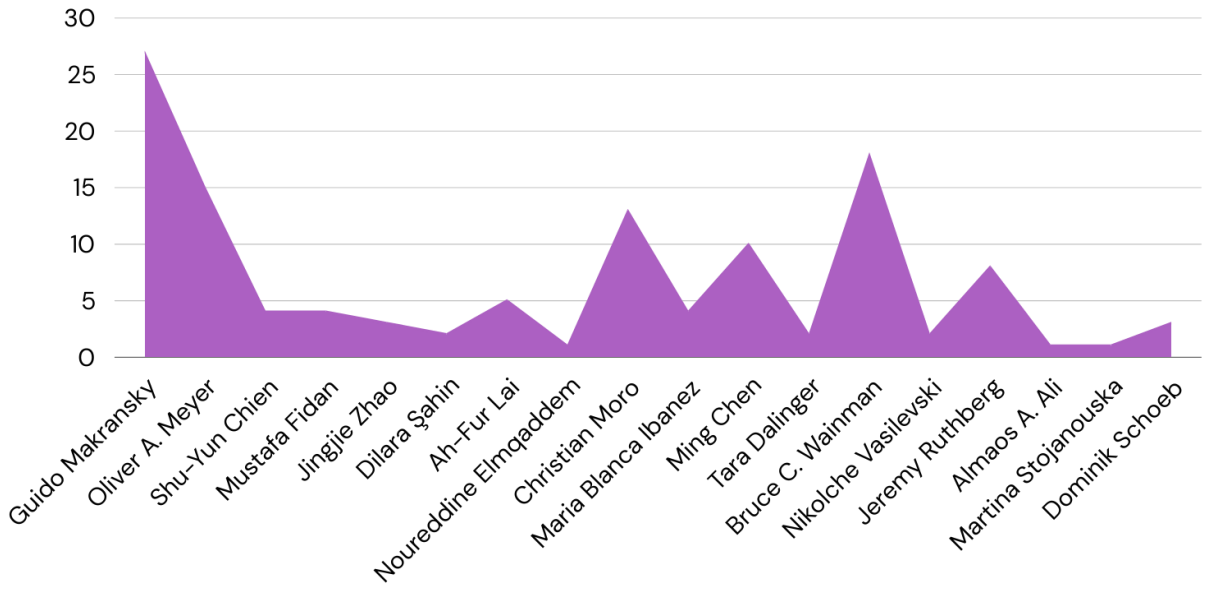


Figure 16 shows that Guido Makransky (n=27), Bruce C. Wainman (n=18), Oliver A. Meyer (n=15), and Christian Moro (n=13) scored higher regarding h-index than the others. Similarly, Figure 14 shows that these authors, except Oliver A. Meyer, published more on AR, VR, and MR technologies. On the other hand, Guido Makransky was the author who has published the most on related technologies in the last five years (Figure 11). Figure 12 shows that Guido Makransky has been the most cited author in the last five years for his educational research with the mentioned technologies. In addition, when the technologies used in this research are considered separately, it can be stated that Bruce C. Wainman ranks second with the number of citations (n=47) in MR research. Figure 15 shows that Wainman had more studies on the Web of Science than other authors. Considering the same figure, Wainman was followed by Gudio Makransky with 76 studies and Christian Moro with 55 studies. Considering all these together, it can be stated that Guido Makransky, Christian Moro, and Bruce C. Wainman contributed more to science on these issues than other authors.

Conclusion and Discussion

In this study, it was determined that educational research conducted with AR and VR technology started to be conducted in the 1990s. Consistent with the findings obtained in this study, some studies in the literature show that the first educational research on AR was conducted in 1999 (Karakus et al., 2019). On the other hand, Rashid et al. (2021) state that the first publication on VR in higher education was made in 1994, which is consistent with the results of this study. However, it was determined that the integration of MR research into education coincided with the mid-2000s. Therefore, it can be said that AR, VR, and MR are relatively new technologies for various disciplines, especially education. In addition, the result of an increase in the number of studies on related technologies in the last five years supports this conclusion. Likewise, it has been suggested that the number of publications in the literature has increased significantly after the 2010s (Hincapie et al., 2021; Liu et al., 2017). Rojas-Sánchez et al. (2023) argued that in recent years, there have been developments in VR-assisted learning processes and significant progress, has been made in the application and use of this technology. This may be because relevant technologies have become a necessity in contemporary education. Similarly, Sala (2021) emphasizes the importance of improving modern educational environments with new technologies, such as AR, VR, and MR. On the other hand, when these technologies are compared, it is seen that VR is used more in education than other reality technologies. This may be because studies with VR technology both started earlier as year and researchers were more familiar with the technology. AR can be envisioned as a variation of virtual environments or VR technology as it is more commonly called (Azuma, 1997). Therefore, it can be thought that researchers do not have sufficient knowledge about AR and MR. However, the increase in the number of AR and MR studies in the last five years shows that the interest in these two technologies has increased. This increase is expected to continue as a search was conducted on 01.10.2023 for this research. In fact, in the search conducted on 20.01.2024 with the same inclusion criteria, it was observed that 112 new publications were made, 34 for AR, 71 for VR, and 7 for MR.

It was found that the keywords virtual reality, augmented reality, education, medical education, simulation, mixed reality, mobile learning, educational technology, and computer-based learning were used more in the studies found in Web of Science. This may be because in most of the studies in the literature, keywords and title or topic are chosen in harmony (Lin et al., 2017; Mirault et al., 2021; Tiwari et al., 2024; Tosik-Gün & Atasoy, 2017) because some researchers suggest that a good headline should include keywords (Gemayel, 2016; Lippi, 2017; Sharma, 2019). On the contrary, it has been observed that the literature also includes expressions that are in the title but not used in the keywords or that are in the keywords but not in the title (Vogel et al., 2006). It is also remarkable that some studies on related technologies do not have any keywords (Hughes & Maas, 2017; Kim, 2006). On the other hand, the fact that virtual reality and augmented reality are the two most used keywords can be directly related to the number of studies. Similarly, the fact that the mixed reality keyword is not ranked third is thought

to be due to the low number of MR publications. In addition, it was observed in the studies that AR, VR, and MR were strongly related to the words self-efficacy, language learning, teachers, usability, and online learning. From this point of view, it can be said that the words related to AR, VR, and MR technologies are frequently used together in the literature (O'Connor & Mahony, 2023; Heintz et al., 2021; Huang, 2022; Özgen et al., 2021; Zhang et al., 2023).

It was found that most of the research on AR, VR, and MR was conducted in the United States and China, respectively. In addition, the fact that the universities conducting the most research on AR, VR, and MR technologies are located in China and that there are four different Chinese universities in the top five ranks supports this situation. In this context, it has been observed that "National Taiwan Normal University" is the university that conducts the most research on AR, VR, and MR technologies. The "National Taiwan University of Science and Technology" followed the relevant university in terms of the number of publications. Therefore, it can be stated that the studies conducted in Asian countries are carried out in certain universities. However, the findings suggest that the research conducted in the United States of America is not clustered in a single university so that there is a distribution of publications in different universities. In the systematic review conducted by Cannizzaro et al. (2022), it was observed that the United States ranked first and China ranked third in terms of AR publications per country. Similarly, Agbo et al. (2021) argue that the United States is the most productive country in terms of publishing articles related to VR in computer science education. This may be because the technologies in question first emerged and were developed in the United States. In fact, Sensorama, the first example of a multi-sensory simulator that incorporates all the features of VR technology, was invented by the American Heilig in 1962 (Gigante, 1993; Wikipedia, 2023). Similarly, the first real AR/VR experience was with the "Sword of Damocles," invented by Ivan Sutherland and his student Bob Sproull at Harvard University in 1968 (Billinghurst et al., 2015; Wikipedia, 2024). On the other hand, Turkey ranked third among the countries where these technologies were integrated into educational research. In a systematic review conducted in Turkey, it was found that studies on educational technology indexed in SSCI, SCI, and ERIC indexes have increased since the beginning of the 21st century (Kucuk et al., 2013). Finally, it was found that there were almost no studies on educational technologies on the African continent, while on the European continent, countries had a more balanced distribution in the number of publications on related technologies.

The findings showed that AR, VR, and MR studies were published more in "Education and Information Technology" and "Interactive Learning Environment" journals, respectively. Following these journals, "Education Sciences," "Computers and Education" and "Journal of Chemical Education" journals included more educational research on related technologies. Likewise, Irwanto et al. (2022) suggested that AR articles in science education are mostly published by the "Journal of Chemical Education" and "Computers and Education". Karakus et al. (2019) also determined that the most important journal in AR-supported education studies is "Computers and Education," according to the bibliographic analysis of journals. Similarly, Rashid et al. (2021) found that "Computers

and Education" is the most influential journal in VR technology, with 39 publications and 3968 citations. Finally, evaluating the number of publications by journal and country together can help to understand the scientific contributions of countries in more depth. In this context, the fact that the first authors of the articles published in the journal "Computer and Education" are generally citizens of the United States or China supports the number of publications determined on a country basis (Hsu et al., 2013). On the other hand, when the journals were compared, it was seen that "Computers and Education" received more citations than the others despite having 51 articles. Therefore, it can be claimed that each article published in the mentioned journal receives an average of thirty-nine citations and this number is higher than the average number of citations per article in other journals.

In the present research, it was determined that three publications by Guido Makransky ranked in the top ten regarding the number of citations. It was seen that the researcher published these studies in 2019. The citation relationships of VR-supported research in the literature from 2015 to 2020 were examined, and it was found that Makransky was the most frequently cited researcher (Cheng et al., 2022). A bibliometric analysis of the Metaverse also emphasized that Makransky is the most cited author (Tas & Bolat, 2022). Similarly, Makransky ranked first among the authors who published the most articles. In addition, when all the studies of the authors included in the systematic review are multiplied by the proportion of first authors, Makransky stands out as the second researcher with the highest number of first authors. Guo et al. (2021) also concluded in their extended reality study that Makransky has the highest number of articles as the first author. On the other hand, Christian Moro was the first in the first author ranking. However, it is remarkable that Moro ranks third in terms of the total number of studies. In line with these results, Guido Makransky, Bruce C. Wainman, Oliver A. Meyer, and Christian Moro, respectively, scored higher than the others in terms of h-index. On the other hand, due to the bibliometric analysis, it is important that there are three articles from Turkey in the top ten, and these studies received a total of 345 citations. In another study, the distribution of AR studies according to the number of citations between 2007 and 2022 was analyzed and it was stated that one study from Turkey ranked in the top ten (Irwanto et al., 2022).

As a result of the examinations, it was seen that AR, VR, and MR studies were mostly conducted with two, three, and four authors. It is also remarkable that there are two studies with six authors and one study each with eight, twelve, and fifteen authors. In another study, AR studies were evaluated regarding the number of authors, and it was determined that the studies generally had two authors (Tezer et al., 2019). In the same study, it was found that the number of studies conducted with at least six authors was high. Four of the studies included in this study cover MR, and one study covers AR. From this point of view, teamwork is needed when implementing applications for MR technology. This may be because MR applications are a very new technology and are less known than AR and VR technologies. Speicher et al. (2019) support this inference by stating that MR was first proposed in 1994 and that discussions about this technology have become more complex as time goes on. On the other hand, it was determined that

some of the related studies emerged as a result of the cooperation of different countries, universities, and departments. In this direction, the findings suggest that research integrating education and technology requires expertise, and more effective results can be obtained with teamwork and cooperation.

Limitations and Recommendations

Although this study has many contributions to the literature, some limitations need to be addressed. The main limitation of this study is that it focuses only on the analysis of studies published in Web of Science. Therefore, it is recommended to expand the documents to be analyzed in further studies with other databases. In other words, the use of databases, such as Scopus or Google Scholar, may lead to different results. In this study, theses, books, or articles were not added to the inclusion criteria. Furthermore, the present study only examined publications in English and did not include research in other languages. Thus, bibliometric studies involving different languages and various types of publications can be conducted in the future. The keywords augmented reality, virtual reality, and mixed reality were used in the study. For a broader analysis of bibliometric data on these technologies, new search terms can be defined that allow the inclusion of other studies related to the field of education. Similarly, inclusion of the keywords mentioned in the present study in the title was accepted as a criterion. However, studies using AR, VR, and MR research as secondary teaching methods or techniques can also increase the knowledge in this field. Hence, scanning the abstract and the title in further studies can provide rich data. Finally, the data sources included in the present study were limited to the field of education. In this direction, multidisciplinary research can be conducted by selecting different fields where AR, VR, and MR technologies are used.

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Genişletilmiş Türkçe Özet

Alan yazın incelendiğinde eğitim alanında AG, SG ve KG teknolojileriyle ilgili ayrı ayrı birçok bibliyometrik analiz çalışması yapıldığı görülmüştür (Arici vd., 2019; Hincapie vd., 2021; Liu vd., 2017; Mani & Madhusudan, 2022; Rojas-Sánchez vd., 2023; Soto vd., 2020; Talan, 2021). Benzer şekilde alan yazınında bahsi geçen teknolojileri ikili olarak ele alan ve bibliyometrik analiz kapsamında gerçekleştiren eğitim araştırmalarına rastlanmıştır (Calabuig-Moreno vd., 2020; Zhao vd. 2023). Ancak AG, SG ve KG teknolojilerini bütüncül bir şekilde ele almamak pedagoji oluşturma fırsatını sınırlamaktadır (Maas & Hughes, 2020). Bu yüzden Zhang vd. (2022) tarafından üç teknolojiyi de içerisinde barındıran bir bibliyometrik analiz yapılmıştır. Ancak bu araştırmada yalnızca cerrahi çalışmalara odaklanılmış ve diğer alanlar göz ardı edilmiştir. Buradan hareketle bu araştırmada üç teknoloji birlikte değerlendirilmiş ve eğitim teknolojilerine yönelik bilgilerin kapsamı artırılmaya çalışılmıştır. Bu durumun eğitimde AG, SG ve KG uygulamalarını inceleyen araştırmacılara, eğitim politikacılarına ve öğretmenlere önemli katkı sağlayacağı düşünülmektedir. Ayrıca bu çalışmanın araştırmacılar için yararlı bir kaynak olacağı öngörülmektedir. Belirtilen gerekçeler doğrultusunda çalışmanın amacı, eğitim alanındaki AG, SG ve KG araştırmalarına yönelik yayınlanan makalelerin bibliyometrik analizini gerçekleştirmektir. Bununla birlikte çalışmada, bibliyometrik analiz verilerine dayalı olarak bir sistematik inceleme yapılarak araştırma eğilimlerine ilişkin daha kapsamlı bilgilere ulaşılması amaçlanmaktadır.

Bu çalışma, çoklu araştırma yöntemine göre tasarlanmıştır. Çoklu araştırma yöntemi, araştırma probleminin incelenmesinde iki veya daha fazla veri toplama yönteminin birlikte kullanılması olarak tanımlanabilir (Cohen vd., 2007). Bu doğrultuda araştırmada iki farklı nitel yöntemden yararlanılmış ve öncelikle bibliyometrik analiz yapılmıştır. Bibliyometrik analizden sonra en fazla atıf alan çalışmaları değerlendirmek amacıyla sistematik inceleme tekniğinden yararlanılmıştır. Araştırmada, tarama yapmak için "augmented reality", "virtual reality" ve "mixed reality" anahtar kelimeleri kullanılmıştır. İlgili anahtar kelimelere göre başlık kategorisi göz önünde bulundurularak 01.10.2023 tarihinde Web of Science veri tabanında bir tarama gerçekleştirilmiştir. Bu kapsamda AG (n=531), SG (n=685), KG'ye (n=71) yönelik toplam 1287 çalışma .txt formatında indirilmiştir. Sistematik incelemeye dâhil edilen makalelerin seçiminde atıf sayıları dikkate alınmıştır. Böylece toplam yirmi doküman gözden geçirilmiştir. Araştırma kapsamında ulaşılan bibliyometrik verilerin analizi, van Eck ve Waltman (2010) tarafından geliştirilen VOSviewer programıyla gerçekleştirilmiştir. Sistematik incelemeye dâhil edilen dokümanlar MaxQda 20 programına aktarılmıştır. Bu kapsamda dokümanlar, yazar sayıları açısından incelenmiştir.

Araştırmada, AG ve SG teknolojisiyle gerçekleştirilen eğitim araştırmalarının 1990'lı yıllarda yapılmaya başlandığı tespit edilmiştir. Bu sonuçlarla benzer olarak alan yazınındaki bazı çalışmalarda AG'ye yönelik ilk eğitim araştırmasının 1999'da yapıldığı görülmektedir (Karakus vd., 2019). Öte yandan Rashid vd. (2021) tarafından yükseköğretimde SG'ye ilişkin ilk yayının 1994 yılında yapıldığının belirtilmesi

araştırmanın sonuçlarıyla tutarlık göstermektedir. Buna karşın KG araştırmalarının eğitimle bütünleştirilmesinin 2000'li yılların ortalarına denk geldiği belirlenmiştir. Buradan hareketle AG, SG ve KG'nin başta eğitim olmak üzere çeşitli disiplinler için nispeten yeni teknolojiler olduğu söylenebilir. Diğer taraftan bu teknolojiler karşılaştırıldığında SG'nin diğer gerçeklik teknolojilerine nazaran eğitimde daha çok kullanıldığı görülmüştür. Bu durum SG teknolojsiyle gerçekleştirilen çalışmaların hem yıl olarak daha önce başlamasından hem de araştırmacıların bu teknolojiye daha fazla aşina olmasından kaynaklanıyor olabilir. Öyle ki AG, sanal ortamların veya daha yaygın olarak adlandırılan SG teknolojisinin bir varyasyonu olarak öngörülebilir (Azuma, 1997).

Web of Science'da bulunan çalışmalarda sırasıyla virtual reality, augmented reality, education, medical education, simulation, mixed reality, mobile learning, educational technology ve computer-based learning anahtar kelimelerinin daha fazla kullanıldığı saptanmıştır. Bu durumun nedeni, alan yazınındaki çoğu araştırmada anahtar kelimeler ile başlık veya konunun uyumlu seçilmesi olabilir (Lin vd., 2017; Mirault vd., 2021; Tiwari vd., 2024; Tosik-Gün & Atasoy, 2017). Çünkü bazı araştırmacılar, iyi bir başlığın anahtar kelimeleri içermesi gerektiğini öne sürmektedir (Gemayel, 2016; Lippi, 2017; Sharma, 2019).

AG, SG ve KG araştırmalarının sırasıyla daha çok Amerika Birleşik Devletleri ve Çin'de yapıldığı tespit edilmiştir. Ayrıca AG, SG ve KG teknolojileriyle alakalı en fazla araştırma yapan üniversitelerin Çin'de yer alması ve ilk beş sıra içerisinde dört farklı Çin üniversitesinin bulunması bu durumu destekler niteliktedir. Bu kapsamda "National Taiwan Normal University"nin AG, SG ve KG teknolojileriyle alakalı en fazla araştırma yapan üniversite olduğu görülmüştür. İlgili üniversiteyi yayın sayısı açısından "National Taiwan University of Science and Technology"nin takip ettiği tespit edilmiştir. Dolayısıyla Asya ülkelerinde yapılan çalışmaların belirli üniversitelerde gerçekleştirildiği ifade edilebilir. Ancak Amerika Birleşik Devletleri'nde yapılan araştırmaların tek bir üniversitede yığılmadığı, böylece yayın açısından farklı üniversitelere yönelik bir dağılım olduğu söylenebilir. Cannizzaro vd. (2022) tarafından gerçekleştirilen sistematik incelemede, ülke başına düşen AG yayınlarında Amerika Birleşik Devletleri'nin birinci, Çin'in üçüncü sırada olduğu görülmüştür. Benzer şekilde Agbo vd. (2021), bilgisayar bilimleri eğitiminde SG ile ilgili makalelerin yayınlanması açısından Amerika Birleşik Devletleri'nin en üretken ülke olduğunu öne sürmektedir. Diğer taraftan bahsi geçen teknolojilerin eğitim araştırmalarıyla bütünleştirildiği ülkeler arasında Türkiye üçüncü sırada yer almıştır. Türkiye'de yapılan bir sistematik incelemede SSCI, SCI ve ERIC indekslerinde taranan eğitim teknolojisine yönelik çalışmaların 21. yüzyılın başlangıcından itibaren artış gösterdiği saptanmıştır (Kucuk vd., 2013).

AG, SG ve KG araştırmalarının sırasıyla "Education and Information Technology" ve "Interactive Learning Environment" dergilerinde daha çok yayınlandığı tespit edilmiştir. Bu dergilerin ardından "Education Sciences", "Computers and Education" ve "Journal of Chemical Education" dergilerinde ilgili teknolojilere yönelik eğitim araştırmalarına daha fazla yer verildiği görülmüştür. Aynı şekilde Irwanto vd. (2022), fen eğitiminde AG

makalelerinin çoğunlukla "Journal of Chemical Education" ve "Computers and Education" tarafından yayınlandığını öne sürmüştür. Karakus vd. (2019) de dergilerin bibliyografik analizine göre, AG destekli eğitim çalışmalarında en önemli derginin "Computers and Education" olduğunu belirlemiştir. Benzer olarak Rashid vd. (2021), "Computers and Education"ın 39 yayın ve 3968 atıf sayısıyla SG teknolojisinde en etkili dergi olduğunu saptamıştır.

Araştırmada, Guido Makransky tarafından gerçekleştirilen üç yayının atıf sayısı açısından ilk on sırada yer aldığı belirlenmiştir. Araştırmacının bu çalışmaları 2019 yılında yayınladığı görülmüştür. Alan yazınında 2015'ten 2020'ye kadar SG destekli araştırmaların atıf ilişkileri incelenmiş ve Makransky'nin en sık atıfta bulunulan araştırmacı olduğu tespit edilmiştir (Cheng vd., 2022). Metaverse üzerine gerçekleştirilen bir bibliyometrik analizde de Makransky'nin en çok atıf alan yazar olduğuna vurgu yapılmıştır (Tas & Bolat, 2022). Benzer şekilde en fazla makale yayınlayan yazarlar sıralamasında Makransky ilk sırada yer almıştır. Ayrıca sistematik incelemeye dâhil edilen yazarların tüm çalışmaları, ilk yazar olma oranlarıyla çarpılınca Makransky, en çok ilk yazar olan ikinci araştırmacı olarak öne çıkmaktadır. Guo vd. (2021) de genişletilmiş gerçeklik çalışmalarında Makransky'nin ilk yazar olarak en fazla sayıda makaleye sahip olduğu sonucuna ulaşmışlardır.

İncelemeler sonucunda AG, SG ve KG araştırmalarının çoğunlukla iki, üç ve dört yazar ortaklığında gerçekleştirildiği görülmüştür. Ayrıca altı yazarlı iki çalışma; sekiz, on iki ve on beş yazarlı birer çalışma olması dikkat çekmektedir. Başka bir araştırmada AG çalışmaları yazar sayısı açısından değerlendirilmiş ve çalışmaların genellikle iki yazarlı oldukları belirlenmiştir (Tezer vd., 2019). Aynı araştırmada en az altı yazarla birlikte yürütülen çalışma sayısının fazla olduğu saptanmıştır. Bu araştırmaya dâhil edilen çalışmaların dördü KG'yi, biri ise AG'yi kapsamaktadır. Buradan hareketle KG teknolojisine yönelik uygulamalar gerçekleştirilirken ekip çalışmasına ihtiyaç duyulduğu düşünülebilir. Bu durum KG uygulamalarının çok yeni bir teknoloji olmasından ve AG ile SG teknolojilerine göre daha az bilinmesinden kaynaklanıyor olabilir. Öyle ki Speicher vd. (2019) tarafından KG'nin 1994'te ilk kez önerildiğinin ve gün geçtikçe bu teknolojiye yönelik tartışmaların karmaşık hale geldiğinin söylenmesi bu çıkarımı destekler niteliktedir.

Ethics Committee Approval: All the rules in the Scientific Research and Publication Ethics Directive were complied with, and none of the "Actions Contrary to Scientific Research and Publication Ethics" in the second part of the Directive were applied.

Informed Consent: Informed consent was obtained from the participants.

Peer Review: This study was peer-reviewed.

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Social Studies Teachers' Opinions on Inclusive Education in the Context of Immigrant Children: Swot Analysis

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Abstract: The aim of this study is to determine social studies teachers' views on inclusive education in the context of immigrant students. For this aim, the opinions of 16 social studies teachers who previously had immigrant children in their classrooms were taken. Phenomenology (phenomenology) design, one of the qualitative research methods, was used in the study. A data collection tool was prepared in line with expert opinion to obtain the views of the participants by taking into account what inclusive education is and the four dimensions of SWOT analysis: Strengths, weaknesses, opportunities, and concerns. A descriptive analysis technique was used to analyze the data. As a result of the study, social studies teachers expressed inclusive education as equality of opportunity and individual differences. Regarding the strengths and opportunities offered by inclusive education in the context of migrant children, teachers stated that it offers equal opportunities, takes into account individual differences, and develops social skills. As for the weaknesses and worrisome aspects of inclusive education, problems arising from overcrowded classrooms, peer bullying, and language problems are among the answers given by teachers. In line with the results obtained in the study, recommendations for inclusive education were presented.

Keywords: Inclusive education, migrant student, social studies teacher, swot analysis.

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Introduction

Education is a concept that has evolved with the progress of human history, taking on different meanings. Education is a lifelong learning process that continues from birth to the end of an individual's life. This learning process is a socialization journey where individuals are provided with information and various skills are developed (Arslan, 2018; Course, 2014;). Education is the most crucial investment that enables countries to build their futures. In order to realize this investment in the best possible way, every person living in society should be included in the education process (United Nation, 2023). In addition to being a fundamental human right, education also has important functions in society. In this context, education is one of the most important tools for ensuring the inclusion of groups that have been ignored due to their various differences and disadvantages (United Nations International Children's Emergency Fund, 2023). In this context, education was first recognized as a right in the Universal Declaration of Human Rights in 1948. The 1960 UNESCO Convention against Discrimination in Education obliges countries to eliminate explicit and implicit barriers to education. In this convention, discrimination is defined as "any distinction, exclusion, limitation or preference based on race, color, sex, language, religion, political or other opinion, national or social origin, economic status or birth which results in unequal treatment of individuals in education" (UNESCO, 2020). The 1989 United Nations Convention on the Rights of the Child defined the special needs of a child with disabilities and emphasized the need to provide free and designed assistance to these children. In addition, it is stated that a child with disabilities should be educated in an educational environment that will enable him/her to meet his/her social needs, socialize and develop individually in a healthy way, and that access should be ensured (UN, 1989; UNESCO, 2020).

The steps taken to ensure equal opportunities and possibilities in education have brought the concept of inclusive education to the forefront. Inclusive education means that all children receive education in the same classrooms, in the same schools. Moreover, it provides a fair opportunity for all students to develop the skills they need to learn and succeed. This educational approach also aims to empower education and provide quality education (UNESCO, 2009; UNESCO, 2020). It particularly aims to find solutions to the educational problems faced by groups perceived as different and disadvantaged in society during the education process (Singh & Kumar Prajapati, 2021; UNESCO, 2009). In this context, the focus is particularly on the inclusion of individuals with special needs in the education process and ensuring that they receive education in the same classrooms alongside other students. Over time, inclusive education has evolved beyond meeting the needs of individuals with special needs, reaching a broader point (UNESCO, 2001; UNESCO, 2009). Inclusive education encompasses all individuals with differences related to income inequality, gender, religion, disability, ethnic background, language, migration, displacement, imprisonment, sexual orientation, gender identity, religion, and other beliefs and attitudes. It aims to overcome issues in the educational context, such as social exclusion, peer bullying, and adaptation

challenges faced by these individuals due to their differences, and to integrate them into educational institutions (UNESCO, 2020). In this context, the Basic Law on Turkish National Education addresses this issue through the article on equality of opportunities and possibilities in education. In the context of this article, "Equal opportunities and possibilities are provided to everyone, regardless of gender, in education. Measures such as free boarding, scholarships, loans, and other assistance are taken to ensure that successful students without financial means receive education up to the highest educational levels." Additionally, there are provisions that 'Special measures are taken to raise and educate children in need of special education and protection" (Basic Law on National Education, 1973). Under this law, inclusive education has come to the forefront. Inclusive education was first mentioned in the Law on Children in Need of Special Education with the number 2916 in 1983. This law specifies that children with special needs who have suitable qualifications should receive education in the same schools as their peers (Education Reform Initiative, 2016; Law on Children in Need of Special Education, 1983). However, the real need for the inclusive education approach in Turkey emerged from the impact of the refugees arriving from Syria, particularly starting from the year 2011. Especially in the year 2016, the Turkish Government decided that this situation is not temporary and that long-term permanent solutions for refugees, including education, need to be developed (Keleş, 2019). In this context, the initial focus was on resolving the language, education system, teacher, and peer adjustment issues faced by refugee students and integrating them into the Turkish education system. During this process, the fundamental goal of the Turkish education system, which is to nurture good citizens, has also been taken into consideration (Gür et al., 2022).

The subject that plays a crucial role in achieving this goal is the social studies course. The social studies course is fundamentally focused on nurturing good citizens for their country and globally fostering responsible individuals. In this context, adapting inclusive education in the social studies course is crucial for the inclusion of both refugee students and other disadvantaged groups in education. There is a connection between the social studies course and inclusive education in terms of purpose, the process of teaching and learning, as well as dimensions of values and skills. The social studies course is fundamentally one of the most important subjects that addresses socialization, socialization processes, and social integration. Therefore, the social studies course aims to raise awareness about stereotypes and prejudices, recognize personal rights and freedoms, promote respect for individuals from different cultures, and instill the understanding that cultural differences are a source of richness (Öner, 2022). Additionally, inclusive education aligns with the goals and achievements of the social studies course, aiming to create a more just and inclusive society (Fırat, 2021). Therefore, implementing the concept of inclusive education in the social studies course will contribute to solving the problems faced by disadvantaged individuals and accelerate socialization processes. Social studies teachers have important responsibilities in ensuring that the inclusive education approach is applied in the social studies course. Social studies teachers need to recognize disadvantaged students in their classrooms,

find solutions to the problems these students are facing, and most importantly, address and resolve issues related to peer integration. Teachers should explore the abilities, interests, and skills of typical or gifted children in their classrooms and employ the necessary strategies, methods, and techniques for their development (Dağlıoğlu et al., 2017). Moreover, they should collaborate effectively with special education and guidance teachers when necessary. However, research shows that social studies teachers find their self-efficacy in inclusive education insufficient, have difficulty in identifying disadvantaged groups (Fırat, 2021), face difficulties due to language differences (Yıldırım, 2017; Yenilmez & Çöplü, 2019; Doğan & Avcı, 2022), cannot communicate with students (Kiremit et al., 2018), and have difficulty integrating inclusive education into their teaching processes. In addition, it has been determined that teachers have difficulties in combating the traumas of refugee students due to psychological reasons (Yenen & Ulucan, 2020), inability to attend classes due to absenteeism (Doğan & Avcıoğlu, 2022), refugee students' feeling inadequate in education (İmamoğlu & Çalışkan, 2017), and inequality of opportunity due to reasons such as housing conditions. They also mention various difficulties, such as insufficient class hours and crowded classrooms (Öner, 2022).

In this context, although there are studies in the literature on the difficulties experienced by social studies teachers in inclusive education, there is no research that includes all aspects of inclusive education. However, there is a need to evaluate all aspects of inclusive education in order to make it a part of the social studies course. When planning inclusive education, it is very important to consider the views of social studies teachers, who are the most important part of the process. In this context, the study aims to determine social studies teachers' views on inclusive education. In line with this objective, answers were sought for the questions below:

1.What are the opinions of social studies teachers regarding what inclusive education is?

2.What are the opinions of social studies teachers regarding the strengths of inclusive education?

3.What are the opinions of social studies teachers regarding the weaknesses (areas that need improvement) of inclusive education?

4.What are the opinions of social studies teachers regarding the opportunities offered by inclusive education?

5.What are the opinions of social studies teachers regarding situations/elements that could pose threats or concerns for inclusive education?

Method

Research Model

In line with the purpose of the study, phenomenology design, one of the qualitative research methods, was used. Phenomenology is a qualitative research design that aims to reach a common understanding of the experiences of a certain group of people about a phenomenon or concept (Creswell, 2013). Within the scope of this method, the perceptions of social studies teachers towards inclusive education were examined, and a comparison was made within the scope of the dimensions of SWOT analysis.

Study Group

The study group consisted of 16 social studies teachers working in public secondary schools between 2022 and 2023.. The study group of the research was selected using the purposive sampling method. Purposive sampling is a sampling method used to enable in-depth study of situations that are thought to have rich information (Patton, 1987). Therefore, when selecting social studies teachers for the study group, attention was paid to their existing or previous experiences with immigrant students in their classrooms. In this context, the information related to the study group is presented in Table 1:

Tablo 1.

Descriptive Information about the Study Group

		n
Gender	Female	8
	Male	8
Duration of Providing Inclusive Education	1-5	13
	5-10	2
	10-15	1

Sixteen of the social studies teachers in the study group taught social studies courses to students who had migrated to Turkey for different reasons.

Data Collection Tools

In the study, a SWOT analysis form was used to draw a general framework for inclusive education. This form includes the four dimensions of the SWOT analysis: Strengths, weaknesses, opportunities, and potential threats or concerns. Additionally, it addresses the question of what inclusive education is. After the draft form was prepared, the

questions were finalized by taking the opinion of 1 social studies teacher. In order to determine whether the questions in the SWOT analysis form were understood, whether they were suitable for teachers to produce answers, and whether they were appropriate in terms of language and expression, the form was finalized by taking the expert opinion of 3 social studies educators. In addition, the form also included descriptive information about the study group, including gender, duration of inclusive education, and the target group(s) for which inclusive education was provided. Accordingly, the following questions were included in the SWOT analysis form.

1.What is inclusive education?

2.What are the strengths of inclusive education?

3.What are the weaknesses (areas that need improvement) of inclusive education?

4.What opportunities does inclusive education provide?

5.What are the situations/elements that could pose threats or concerns for inclusive education?

Before the SWOT analysis form was applied, social studies teachers were contacted by phone and informed about the research. Then, the SWOT analysis form was delivered to social studies teachers via Google Forms.

Data Analysis

A descriptive analysis technique was used to analyze the research data. In this context, categories were first created based on the dimensions of SWOT analysis. Considering these categories, the data were read and organized by the researchers. The organized data were coded by the researchers, and direct quotations were determined. During this process, the data were reviewed again by making direct quotations. In this direction, codes were created by reaching a final decision as a result of two codings (Merriam, 2009).

Validity and Reliability

Within the scope of the research, expert opinion was utilized to ensure validity and reliability. In addition, the findings of the research were supported with direct quotations to ensure the validity and reliability of the research.

Findings

The findings of the study were analyzed and presented under the titles of what inclusive education is, strengths of inclusive education, weaknesses (areas that needed

improvement) of inclusive education, opportunities provided by inclusive education, and elements that could pose threats or concerns in inclusive education.

1.The Findings Regarding What Inclusive Education Is

Table 2 presents the opinions of social studies teachers on what inclusive education is.

Table 2.

Social Studies Teachers' Opinions on What Inclusive Education is

What is Inclusive Education	f
Equal Opportunity	12
Individual Difference	8

When the findings in Table 2 are analyzed, social studies teachers defined inclusive education as equality of opportunity and individual difference. In this context, P1 defined inclusive education as "*focusing on other groups facing difficulties in receiving equal and quality education, such as children from impoverished backgrounds, those with different ethnic and cultural backgrounds, and girls living in rural areas.*" P2 defined inclusive education as "*Ensuring that all students in the education system receive education in line with their interests and needs. It is to embrace all students equally.*"

2.Findings on the Strengths of Inclusive Education

Social studies teachers' opinions on the strengths of inclusive education are given in Table 3.

Table 3

Social Studies Teachers' Opinions on the Strengths of Inclusive Education

Strengths of Inclusive Education	f
Considering Individual Difference	4
Equal Opportunity	3
Accelerating Social Cohesion	1
Facilitating the Learning Process	1
Strengthening Communication	1
Achievement Self-Efficacy	1

Peer Learning	1
Supporting Individual Development	1
Respect for Differences	1
Ensuring Socialization	1
Preventing Social Segregation	1
Providing Self-Confidence	1

According to the findings in Table 3, one of the participants, P1, described the strengths of inclusive education as "*...It allows the individual to socialize. It prevents social segregation. It enables the individual to realize himself/herself and create an environment of self-confidence...*". P4 stated that "*Inclusive education is valuing diversity and not excluding anyone from educational processes due to reasons such as gender, ethnicity, social class, health, social participation and achievement and embracing everyone by the system*", P15 stated that "*All students benefit from educational opportunities under equal conditions, there is equality of opportunity, students learn from each other, increase self-confidence ...*", and P16 stated that "*It sees students of all abilities as valuable...*".

3.Findings on the Weaknesses of Inclusive Education

Table 4 includes the opinions of social studies teachers regarding the weaknesses (areas that need improvement) of inclusive education.

Table 4

Opinions of Social Studies Teachers on the Weaknesses (Areas that Need Improvement) of Inclusive Education

The Weaknesses (Areas that Need Improvement) of Inclusive Education	f
Problems arising from overcrowded classrooms	3
Ignoring Individual Differences	2
Time Problem	2
Failure to Provide Equal Opportunity	1
Reducing Academic Success	1
Problems arising from Adaptation	1

Peer Bullying	1
Superficialization of Content	1
Lack of Resources	1
Low Number of Guidance Counselors	1
Insufficient Guidance Services	1

According to the findings in Table 4, one of the participants, P2, expressed the weaknesses (in need of improvement) of inclusive education as "*The lack of organized resources that we can get help for planning during extracurricular time...*". P3 of the participants said "*Inadequacy of school guidance services in student identification and the scarcity of guidance teachers in schools...*", P5 said "*I think that it can remain much more superficial under a single educational roof*", according to P12 "*Good students can go backwards in terms of success...*".

4.Findings on the Opportunities Provided by Inclusive Education

Social studies teachers' opinions on the opportunities offered by inclusive education are presented in Table 5.

Table 5

Social Studies Teachers' Opinions on the Opportunities Provided by Inclusive Education

Opportunities of Inclusive Education	f
Ensuring Equal Opportunity	5
Improving Social Skills	3
Increasing Academic Success	2
Increasing Self-Confidence	2
Improving Communication Skills	1
Providing a Different Perspective	1
Increasing Respect for Differences	1

According to the findings in Table 5, P2 of the participants stated that "...*Teachers and students have contributed to the development of social skills by entering into effective communication with different cultures, races and ethnic groups*", P3 underlined that "*It*

enables students to socialize, it is a great opportunity for asocial students", P14 stated "*Equality of opportunity, providing education by taking into account the needs of the child, increasing the child's self-confidence*".

5. Findings Regarding Situations/Elements that Could Pose Threats or Concerns to Inclusive Education

Table 6 presents the opinions of social studies teachers on the situations/elements that may pose a threat or concern towards inclusive education.

Table 6.

Findings Regarding Situations/Elements that Could Pose Threats/Concerns to Inclusive Education According to Social Studies Teachers

Situations/Factors that may pose threats/concerns to inclusive education	f
Peer Bullying	4
Language Problem	2
Discrimination	1
In-Class Conflict	1
Decreasing Academic Achievement	1
Teacher Insufficiency	1

According to the findings in Table 6, P1 expressed his opinion as "*...I may have concerns about whether I am sufficient to implement inclusive education...*" regarding the situations/elements that may pose a threat/concern for inclusive education. P2 one of the participants said, "*Problems are observed more for migrant students. Such as discrimination and marginalization. There is a language problem. This situation causes their academic success to weaken*", P4 stated that "*...The exclusion of these students among students is a threat to inclusive education...*" P10 said "*In-class conflicts and peer bullying may occur...*".

Results and Discussion

This study was conducted to determine social studies teachers' opinions on immigrant students in the context of inclusive education. In the study, teachers were asked what inclusive education is, its strengths, the opportunities it offers, and the weaknesses of

inclusive education, and the data were analyzed in line with the answers given, and the results were reached.

While in the past, inclusive education was expressed as an education for children with disabilities who need special education and children who do not need special education to be educated together, today, it includes the studies carried out for the education of children who we can call disadvantaged groups and who have difficulties in terms of education (UNESCO, 2009; UNESCO, 2020; Singh & Kumar Prajapati, 2021). In the study, teachers were first asked what inclusive education is. It was determined that teachers expressed inclusive education as equality of opportunity and individual differences. In Fırat's (2021) study, teachers were asked to define inclusive education, and it was observed that teachers highlighted features such as providing equal opportunities and considering individual differences in their definitions, similar to what is emphasized in this study. In the study of Doğan and Avcıoğlu (2022), in which they examined the problems of immigrant students based on inclusive education, it was concluded that teachers from different branches expressed equality of opportunity the most in their explanations about inclusive education.

As a result of the study, social studies teachers have expressed that the strong aspects of inclusive education in the context of immigrant students include considering individual differences, providing equal opportunities, accelerating social integration, facilitating peer learning, fostering respect for differences, promoting socialization, and enhancing self-confidence. Furthermore, teachers have stated that inclusive education, in line with what they expressed as its strengths, provides equal opportunities, enhances communication skills, and increases students' self-confidence. Among the opinions of teachers, it is also noted that inclusive education enhances students' social skills, provides them with different perspectives, increases academic achievements, and fosters sensitivity to diversity. The conclusion drawn in the study, indicating that inclusive education supports peer learning in line with teachers' opinions, parallels the results of other studies in the literature. In the study conducted by Tosun et al. (2018), which addresses the challenges related to the education of immigrant students, it is revealed that teachers highlight the exchange of information among students in classrooms with immigrant students as an advantage of a multicultural environment. Alpaslan (2019) examined the views of social studies teachers on Syrian students and stated the importance of peer learning in line with the views of teachers. In the study, the teachers stated that one of the ways they follow in solving Syrian students' problems related to learning is peer support, and in doing so, they ask Turkish-speaking Syrian students to translate and explain the subjects explained by the teacher to their friends, and they ensure that students receive support from each other while doing activities. This situation contributes to the solution of the communication problem to a certain extent. Yıldırım (2020) examined inclusive education for refugee students in social studies courses and found that teachers emphasized the need to support peer learning for inclusive education.

As a result of the study, one of the responses provided by teachers regarding the opportunities offered by inclusive education is that it strengthens communication. In their study to determine the educational challenges faced by migrant students, Tosun et al. (2018) found that migrant students reported teachers encouraging them to communicate with peers by using simple sentence patterns and involving them in various projects within the classroom environment. This also contributes to reducing the communication problems experienced by migrant students.

People migrate to other countries for many different reasons, such as wars, economic reasons, disruption of social order, unfavorable health conditions, and natural disasters. These migrants try to adapt to the culture and living conditions of the society they migrate to by reshaping their own conditions. In this sense, education is an important tool for migrants to adapt to their new environment and living conditions (Doğan & Avcıoğlu, 2022). Another result of the study is that teachers stated that inclusive education accelerates the social adaptation of migrant students as one of its strengths. Children constitute the group most affected by migration. In this sense, the arrangements to be made in the education and school environment, especially for children, will accelerate and facilitate their adaptation process to society, and in this sense, inclusive education is a structure that includes all these features. Inclusive education not only improves learning environments but also provides opportunities for all students to succeed in their learning experiences. Inclusive learning environments provide equal and adequate learning opportunities to all students who have differences in terms of their learning levels, interests, needs, cultural characteristics, and past experiences without any discrimination (Saka & Çelik, 2022). Individual differences in education can be related to students' readiness levels, interests, abilities, and learning styles; being a child of a broken family; being exposed to disasters; needing special education; gender inequality; as well as having disadvantages such as being a refugee-asylum-seeker-migrant. Inclusive education is considered necessary because it accepts all these individual differences and acts with the understanding of education for all and will help to ensure the integration of all individuals who have difficulties in self-realization, access, and participation in education and who are subjected to discrimination (Fırat, 2021). One of the answers given by social studies teachers regarding the strengths of inclusive education is that inclusive education takes into account individual differences. Today, due to phenomena such as social movements, migration, coexistence of people from different origins, and globalization, it has become inevitable for educational environments to be multicultural. This situation necessitates an educational approach where individual differences are perceived as richness and are sustained (Kozikoğlu & Yıldırımoğlu, 2021). In this regard, the results of the study indicate that teachers, in the practitioner position, hold the view that inclusive education supports individual differences. This suggests that teachers, in their practical roles, implement inclusive education in a way that supports individual differences.

The study's results reveal that social studies teachers, in the context of immigrant students, have expressed concerns about the weak aspects of inclusive education. These concerns

are related to problems arising from overcrowded classrooms, neglect of individual differences, peer bullying, and the inability to provide equal opportunities. Teachers mentioned the time problem as one of the weaknesses of inclusive education in the context of migrant students. This result of the study is supported by other studies in the literature. In a study conducted by Alpaslan (2019) that examines the opinions of social studies teachers on Syrian students, some teachers expressed that they experienced various problems with immigrant students in terms of academic or adaptation but mentioned that they could not always allocate enough time to students when faced with such situations. In Aydeniz and Sarıkaya's (2021) study on the educational problems of migrant students, teachers expressed the time problem in the education of migrant students and stated that in order to ensure educational equality for students, the necessary time as well as the necessary environment should be provided. Bayram and Öztürk (2020) examined the opinions of social studies teachers on inclusive education and found that one of the obstacles in organizing the learning-teaching process with an inclusive approach was the intensity of the curriculum and the lack of class hours. Ünal and Aladağ's (2020) study, where they examined teachers' views on problems and solutions in the context of inclusive education practices, aligns with Fırat's (2021) study on inclusive education in social studies. Both studies seem to parallel each other in terms of their outcomes. One of the main problems of migrant students is language. The language problem that students experience brings many problems for them in the school environment, such as not being able to communicate, not being able to understand the lessons, and not being able to express themselves, are just a few of them. These problems may not be addressed by teachers for students during the available class hours, which is why teachers cite the time problem as one of the weaknesses of inclusive education.

It can be said that the opinions of social studies teachers about the weaknesses of inclusive education in the context of migrant students, such as adaptation problems, peer bullying, and low academic achievement, are based on the language problem experienced by the students and the inability of their parents to fully realize their roles in the education process. As a matter of fact, immigrant students cannot adapt to the environment they live in due to the language problem they face, they cannot succeed academically because they cannot understand the lessons, and they may be exposed to peer bullying because they cannot communicate with other students in the classroom. The result of this study aligns with Zayimoğlu Öztürk's (2018) evaluation of the education-teaching services offered to refugee students based on the views of social studies teachers. It also parallels the findings of Doğan and Telli (2022), who determined perspectives on inclusive education, Seçgin and Eren Özalp's (2020) examination of the problems faced by immigrant students in social studies classes, and Uysal's (2022) meta-analysis of research on social studies and immigrant students. Again, Dryden (2015), in his study on immigrant/refugee students, stated that students have language problems both in daily life and in the school environment, especially in the country they immigrated to. In addition, he stated that students spend a lot of effort to overcome the language problem they experience, that this effort is disproportionate

and as a result, they fall behind in the course content. In his study, Yıldırım (2020) indicated that the shyness of refugee students based on language problems directly affected their participation in classes. He also mentioned the issue of resource shortage and concluded that in classes, materials such as textbooks and activity books were used. Similarly, in this study, teachers have expressed that there is a lack of resources in the context of immigrant students.

One of the significant findings obtained in the study is the teachers' observation and reporting of inadequacies in their ability to address the education of immigrant children within the context of inclusive education. In the studies conducted by Tosun et al. (2018), a significant portion of teachers who teach foreign national students in the education process express that they have not received any in-service or supplementary training on how to educate these students in terms of multiculturalism, intercultural education, and similar aspects. When this result is evaluated, it can be said that teachers have not received sufficient training regarding the education of immigrant students. Indeed, in the study conducted by Temur and Özalp (2022), where they assessed the problems and solution proposals of classroom teachers for immigrant students, they indicated that, despite the inclusion of topics such as inclusive education, individual differences in education, and differentiated instruction in teacher education in Turkey, the results of their research showed that the training was insufficient or remained theoretical. In the study conducted by Ünal and Aladağ (2020), teachers expressed feeling inadequate in planning education for students under temporary protection. They also mentioned that in-service training activities on inclusive education were not sufficient. Additionally, the results of the studies by Erden (2020), Bayram and Öztürk (2021), Doğan and Telli (2022) and Doğan and Avcıoğlu (2022) demonstrate similarity. Lew (2012), in his study in which he examined the mandatory requirements in teacher training for the education of migrant students, states that teacher training is an important requirement for the education of migrant students to fully achieve its purpose. In addition to the effectiveness of teachers in the education of migrant students, the study also states that teachers have important duties in terms of evaluating the learning process of students. Rutkowski et al. (2014), in their study on immigrant students in Europe, state that the positive relationships that immigrant students establish with teachers facilitate their adaptation to school as well as increase their academic achievement.

In the process of inclusive education, it is very important that stakeholders within the school, especially guidance services, are involved in the process. Guidance services have important roles in facilitating the adaptation of migrant students to school, identifying the source of problems, and eliminating them. As a result of the study, teachers stated that the guidance services in schools were inadequate, and that this situation affected them as much as the students and that they could be insufficient in some issues related to students because they could not receive the necessary guidance service support. These results of the study are in parallel with the studies in the literature. Ayan Ceyhan (2016), Bayram and Öztürk (2021), Saka and Çelik (2022) stated in their

studies that the quality of guidance services provided for inclusive education in schools on both a teacher and student basis is insufficient.

Recommendations

In recent times, the increase in migrations to our country has led to a rise in the number of immigrant students, consequently impacting the overall population of these students in the educational environment. School plays an important role in the social adaptation of these students. The importance of inclusive education in schools in ensuring the adaptation process of students to society is very important, and as a result of the study, teachers mentioned the positive aspects of inclusive education in schools in this sense, but also expressed the problems experienced. As one of the most important of these problems, teachers emphasized the inadequacy of their own training, and in this case, it can be said that seminars or trainings given to teachers on inclusive education in the context of migrant children should be increased. However, teachers particularly drew attention to the language problems and lack of materials that children experience. In this sense, cooperation between schools and the Ministry of National Education can be improved. In this study, social studies teachers' opinions on inclusive education in the context of immigrant children were evaluated. In the study, it was determined that social studies teachers evaluated the weaknesses, threats and concerns of inclusive education together. Research can be conducted to analyze the weaknesses, threats and concerns of inclusive education by social studies teachers in detail.

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Genişletilmiş Türkçe Özet

Sosyal bilgiler dersi tarihi, kültürü, toplumsal sorumlukları vb. öğrencilere kazandırmayı, toplumsal uyumu sağlamayı ve öğrencilerde içinde bulundukları topluma karşı biz duyusunu geliştirmeyi amaçlayan, ülkesi için iyi vatandaşlar ve küresel bağlamda iyi bireyler yetişmeye odaklanan bir derstir. Bu nedenle, sosyal bilgiler dersi, göçmen öğrencilerin toplumsal entegrasyonuna sağlama ve eğitime adaptasyonunda oldukça önemli bir konumdadır. Sosyal bilgiler dersini kapsayıcı eğitime uyarlamak hem göçmen öğrencilerin hem de diğer dezavantajlı grupların eğitime dahil edilmesinde oldukça önemlidir. Bu nedenle, bu ders kalıp yargı ve ön yargıları fark etmeyi, kişisel hak ve özgürlükleri farkına varmayı, farklı kültürlerden gelen bireylere saygılı olmayı ve kültürel farklılıkların zenginlik olduğunu benimsetmeyi amaçlamaktadır (Öner, 2022). Bununla birlikte, kapsayıcı eğitimin daha adil ve kapsayıcı bir toplum oluşturma amacı sosyal bilgiler dersinin de amaçlarıyla örtüşmektedir (Fırat, 2021). Kapsayıcı eğitim anlayışının sosyal bilgiler dersinde uygulanabilmesi için sosyal bilgiler öğretmenlerine önemli görevler düşmektedir. Sosyal bilgiler öğretmenlerinin sınıflarında bulunan dezavantajlı öğrencileri fark etmeleri, bu öğrencilerin yaşadıkları sorunlara çözüm üretmeleri ve akranlarıyla yaşanan uyum sorunlarını çözmeleri, sınıflarında bulunan tipik ya da üstün yetenekli çocukların yetenekleri, ilgileri ve becerilerini keşfetmeleri ve bunların gelişmesi için gerekli strateji, yöntem ve teknikleri kullanmaları gerekmektedir (Dağlıoğlu vd., 2017). Bununla birlikte, gerektiğinde özel eğitim ve rehber öğretmenleriyle uyum içinde çalışmalıdırlar. Ancak yapılan araştırmalarda sosyal bilgiler öğretmenlerinin kapsayıcı eğitim anlamında kendilerini yetersiz buldukları (Fırat, 2021), dil farklılığından dolayı sorunlar yaşandıkları (Yıldırım, 2017), kapsayıcı eğitimi eğitim-öğretim süreçlerine entegre etmekte zorlandıkları, ders saati azlığı ve sınıf mevcudunun kalabalık olmasından dolayı (Öner, 2022) çeşitli sorunlar yaşadıkları tespit edilmiştir. Bu kapsamda, araştırmada sosyal bilgiler öğretmenlerinin kapsayıcı eğitime yönelik görüşlerini belirlemek amaçlanmıştır.

Bu dersin uygulayıcısı olan öğretmenler bu sürecin sağlıklı yürütülebilmesini etkilemektedirler. Bu nedenle, araştırma kapsamında sosyal bilgiler öğretmenlerinin kapsayıcı eğitime yönelik görüşlerini belirlemek amaçlanmıştır. Bu amaç doğrultusunda aşağıda yer alan sorulara cevap aranmıştır:

1.Sosyal bilgiler öğretmenlerinin kapsayıcı eğitiminin ne olduğuna ilişkin görüşleri nelerdir?

2.Sosyal bilgiler öğretmenlerinin kapsayıcı eğitimin güçlü yönlerine ilişkin görüşleri nelerdir?

3.Sosyal bilgiler öğretmenlerinin kapsayıcı eğitimin zayıf (geliştirilmesi gereken) yönlerine ilişkin görüşleri nelerdir?

4.Sosyal bilgiler öğretmenlerinin kapsayıcı eğitimin sunduğu fırsatlara ilişkin görüşleri nelerdir?

5.Sosyal bilgiler öğretmenlerinin kapsayıcı eğitime yönelik tehdit/endişe oluşturabilecek durumlar/unsurlara ilişkin görüşleri nelerdir?

Araştırma nitel araştırma yöntemlerinden fenomenoloji (olgubilim) deseni kullanılarak gerçekleştirilmiştir. Feomenoloji; belli bir insan topluluğunun bir fenomen ya da kavramla ilgili deneyimlerini ilişkin ortak anlama ulaşmayı amaçlayan nitel araştırma desenidir (Creswell, 2013). Araştırmanın çalışma grubunu 2022-23 Mîlli Eğitim Bakanlığı'na bağlı devlet ortaokullarında görev yapan ve sınıflarında göçmen öğrenciler bulunan 16 sosyal bilgiler öğretmeni oluşturmuştur. Araştırmanı verileri yarı-yapılandırılmış görüşme formu aracılığıyla toplanmıştır. Bu form oluşturulurken; SWOT analizi kapsamında, kapsayıcı eğitimin güçlü yönleri, zayıf (geliştirilmesi gereken) yönler, sunduğu fırsatlar ve tehdit/endişe oluşturabilecek durumlar/unsurlar boyutları ve kapsayıcı eğitim nedir soruları esas alınmıştır. Araştırmanın verileri betimsel analiz tekniği kullanılarak analiz edilmiştir. Betimsel analiz kapsamında, ilk olarak SWOT analizinin boyutları esas alınarak kategoriler oluşturulmuştur. Bu kategoriler göz önünde bulundurularak veriler araştırmacılar tarafından okunmuş ve düzenlenmiştir. Düzenlenen veriler araştırmacılar tarafından kodlanarak doğrudan alıntı yapılacak yerler belirlenmiştir. Daha sonra aradan bir hafta geçtikten sonra veriler tekrar okunarak kodlanmıştır. Bu esnada doğrudan alıntı yapılarak veriler tekrar gözden geçirilmiştir. Bu doğrultuda iki kodlama sonucunda nihai karar varılarak kodlar oluşturulmuştur (Merriam, 2009). Araştırmada geçerlik ve güvenirliği sağlamak amacıyla uzman görüşü alınmıştır. Bununlar birlikte, araştırmanın bulguları doğrudan alıntılar yoluyla desteklenmiştir.

Araştırmanın sonucunda elde edilen sonuçlar şu şekildedir; sosyal bilgiler öğretmenleri kapsayıcı eğitimi; fırsat eşitliği ve bireysel farklılık olarak tanımlamışlardır. Kapsayıcı eğitimin güçlü yönlerine öğretmenler; bireysel farklılığı dikkate alma, fırsat eşitliği sunma, toplumsal uyumu hızlandırma, öğrenme sürecini kolaylaştırma, iletişimi güçlendirme, bireysel gelişimi destekleme, farklıklara saygı, sosyalleşmeyi sağlama, toplumsal ayrışmayı önleme ve özgüven sağlama olarak görüş belirtmişlerdir. Kapsayıcı eğitimin zayıf (geliştirmesi gereken) yönlerini; bireysel farklıkları göz ardı etme, zaman problemi, fırsat eşitliği sağlayamama, akademik başarıyı azaltma, uyum probleminden kaynaklı sorunlar, akran zorbalığı, içeriğin yüzeyselleştirilmesi, kaynak eksikliği, rehber öğretmen sayısının az olması ve rehberlik servislerinin yetersiz olması olarak ifade etmişlerdir. Kapsayıcı eğitimin sunduğu fırsatları; fırsat eşitliği sağlama, sosyal becerileri geliştirme, akademik başarıyı arttırma, özgüven duygusunu arttırma, iletişim becerisini geliştirme, farklı bakış açısı sağlama, farklıklara saygıyı arttırma olarak belirten öğretmenler kapsayıcı eğitime yönelik tehdit/endişe oluşturabilecek durumlar/unsurlara yönelik; akran zorbalığı, dil sorunu, ayrımcılık, sınıf içi çatışma, akademik başarıyı azaltma ve öğretmen yetersizliği olarak görüş bildirmişlerdir. Araştırmanın sonuçları doğrultusunda, öğretmenlere verilen kapsayıcı eğitimi konusunda eğitim ve seminerlerin artırılması, göçmen öğrencilerin yaşadıkları dil sorununa, materyal eksikliklerine yönelik Millî Eğitim Bakanlığıyla iş birliğinin geliştirilmesi şeklinde önerilerde bulunulmuştur.

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Peer Review: This study was peer-reviewed.Authors'

Authors' Contribution: 1st author: %50; 2nd author: %50

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Creating Digital Storytelling as Digital Materials in Mathematics Education*

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Abstract: The digitalization of stories through technology-supported software has created the concept of digital stories. In recent years, researchers have been making efforts to investigate the effects of digital stories that have started to be used as digital materials in education. This study aims to evaluate the digital stories created by preservice mathematics teachers for mathematics courses, their experiences in the process of creating digital stories, and their views on the use of digital storytelling as digital materials in mathematics courses. This qualitatively designed study was conducted with the participation of 49 preservice elementary mathematics teachers and lasted 7 weeks. It was found that the digital stories created by the participating preservice teachers were moderately acceptable. Participants characterized digital storytelling as materials that are interesting, support teaching, and provide visual richness. They also stated that they intended to use digital storytelling when they begin working as teachers. However, due to the time-consuming nature of the process, most participants stated that they would use ready-made digital stories instead of creating them themselves. Additionally, the results of this study provide information about the experiences of preservice teachers regarding the process of creating digital storytelling.

Keywords: Digital storytelling, Digital materials, Teacher education, Mathematics education.

About the Article

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Introduction

Technological developments make it possible to use digital materials in educational environments. Digital materials provide educators and students with opportunities to improve their knowledge and skills, thus increasing educational standards (Smeda et al., 2014). Particularly since the outbreak of COVID-19, the contribution of digital materials to education has become increasingly important, and people have become more conscious about the use of digital materials. The range of digital materials is considerably wide (Schneider et al., 2022). One type of digital material used in education is digital storytelling (DS). Although DS are mostly associated with arts and humanities, they can also be used as effective teaching materials in quantitative courses such as mathematics (Sadik, 2008; Wu & Chen, 2020).

Digital Storytelling

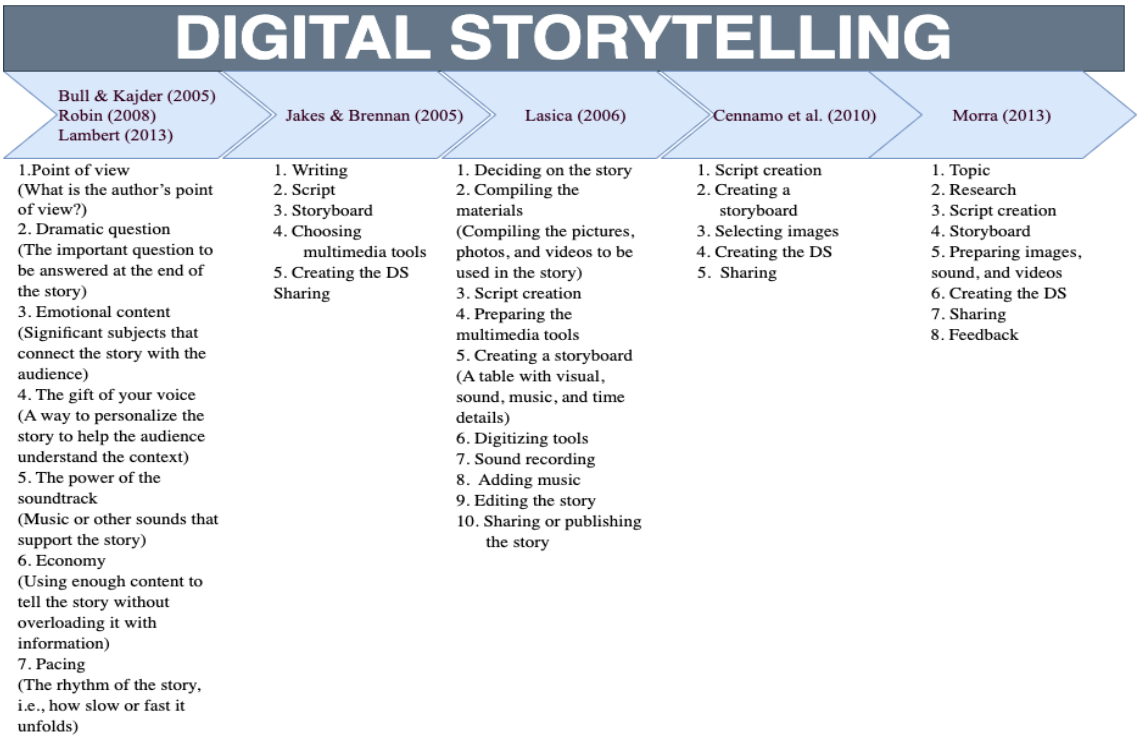
DS entails the presentation of a story on a certain topic in a digital environment (Çetin, 2021; Kobayashi, 2012) or, in other words, the enrichment of a story through the use of multimedia tools (Yilmaz & Durak, 2018). The concept of digital storytelling (DS) is based on combining the art of storytelling with various digital multimedia resources, such as images, audio, and video. DS combine text, audio, video, graphics, and music to present information about a particular topic using technology (Chung, 2007; Robin, 2006, 2008; O'Byrne et al., 2018). DS can also be described as tools for individuals to convey their feelings and thoughts (Kocaman-Karoglu, 2016; Ng, 2015) or to convey complex concepts through both linguistic and non-linguistic means (Kim & Li, 2021; Kim et al., 2021).

Digital storytelling (DS) is based on the traditional concept of storytelling, bearing both similarities and differences to it. Similar to traditional stories, DS are created around a chosen theme or topic. They focus on a specific point of view. They can be written to tell about a personal event, to relate a historical event, or to provide information on a particular topic (Robin, 2006, 2008). DS involve traditional story-making processes such as choosing a topic, conducting research, writing a script and turning it into an interesting story, brainstorming, and creativity (O'Byrne et al., 2018; Saritepeci, 2021; Robin, 2008). The difference between DS and traditional stories is that DS are supported by various digital multimedia tools (O'Byrne et al., 2018). DS can be created at a basic level without using any additional technology, or they can be enriched by using different applications and software (Yilmaz & Sığirtmaç, 2023). The latter typically involves the combination of narratives in short video format of 2-6 minutes (Jakes & Brennan, 2005; McLellan, 2007; Ng, 2015; Kim et al., 2021; Kocaman-Karoglu, 2016), usually consisting of 20-25 images, with still images and occasionally animated images and music (McLellan, 2007). The short and concise structure of DS eliminates the text and word complexity of traditional stories (Kim et al., 2021). It is important to choose the appropriate technological tools according to the subject content of DS (Yilmaz & Durak, 2018). Many digital tools are used for creating DS. PowToon, Slidely, Storybird, Puppet Pals, Movie Maker, PowerPoint, Tellagami, StoryJumper, iMovie, and GoAnimate are

among the most popular ones. These tools offer many options to users who want to create DS, such as recording their own voices and music, using ready-made visuals as well as pre-existing visuals of their choice, and drawing (Büyükkarcı & Müldür, 2022). DS can be uploaded to websites or printed (Robin, 2008). Sharing the final product of the creative process offers the opportunity to communicate with peers, colleagues, administrators, and parents (Kim et al., 2021). Moreover, digital tools are inexpensive and widely accessible, which makes DS both personal and universal at the same time. Therefore, DS are powerful learning and communication tools (Chang & Chu, 2022; Sadik, 2008; McLellan, 2007).

There is no clear theoretical framework for DS used to enhance technology effectiveness in the classroom (Robin, 2008; Smeda et al., 2010). In general, the process of creating DS consists of two dimensions. The first dimension is the creation of the story within a given context and the script-writing stage, and the second dimension is the stage of using technology integration within the framework of the established script (Saritepeci, 2021; Wang & Zhan, 2010; Büyükkarcı & Müldür, 2022). In the literature, different researchers have categorized the DS creation process within different dimensions (Figure 1). Robin (2008) focused on seven elements identified by the Center for Digital Storytelling (2005). These elements constitute the seven elements of DS, which are considered the starting point for working on a DS. Cennamo et al. (2010) described the process of DS creation in five stages. Lasica (2006), on the other hand, outlined a ten-stage process by describing the elements of a DS in a broader scope. When the stages of DS creation are examined, it is seen that the most basic elements of DS are having a point of view and a purpose for the story; writing a script suitable for the story; selecting audio, video, and music suitable for the script; and creating and sharing the DS.

Figure 1. Stages of creating a DS



Digital Storytelling in Education

DS are used in almost every aspect of life, from health to museums and from commerce to human resources. Perhaps one of the most important areas where DS are used the most is education. It is possible to see the use of DS at every level of education, from preschool to university, and in many disciplines (Ciğerci & Yıldırım, 2023; Nunvářová et al., 2022; Wu & Chen, 2020). Wang and Zhan (2010) emphasized that DS are becoming powerful learning materials in educational settings and an effective way to draw the attention of both teachers and students. DS have the potential to transform and improve students' learning (O'Byrne et al., 2018; Korukluoğlu & Toy, 2022); they are effective learning tools (Chung, 2007; Dreon et al., 2015) and constitute a new learning method (Nunvářová et al., 2022; Yilmaz & Durak, 2018). In particular, using technology-supported DS can be a unique way to teach difficult and complex concepts. DS offer opportunities to readers who have difficulty comprehending the material to be learned to visually make sense of or imagine it (Bull & Kajder, 2005; Kajder & Swenson, 2004).

DS created by combining human creativity with technology are characterized as student-centered interactive learning and materials that can transfer learning to technology-rich environments (Smeda et al., 2014). Therefore, DS offer teachers and students opportunities to use technology effectively (Robin, 2006, 2008). Barrett (2006) stated that DS facilitates four main student-centered learning strategies: engagement, deep

learning, project-based learning, and technology integration. In addition, there is a prevailing view that DS used in education are tools that encourage individuals to develop skills of information-gathering, problem-solving, and critical thinking together with aesthetic awareness (Chung, 2007; Çetin, 2021; Kim et al., 2021; McLellan, 2007; Yilmaz & Durak 2018; Walters et al., 2018). The DS used in learning environments contribute to the development of students' skills such as using technology (Korukluoğlu & Toy, 2022; Smeda et al., 2014), learning based on collaboration and peer communication, and taking personal initiative (McLellan, 2007; Yilmaz & Durak 2018). Furthermore, DS created with digital technologies offers open-ended and creative learning experiences for both teachers and students (Yang & Wu, 2012). DS are materials that have the potential to increase students' engagement in lessons and provide better learning outcomes (Smeda et al., 2014). They also support learning by contributing to the concretization of content (Yilmaz & Siğirtmaç, 2023). Churchill (2020) emphasized that DS are digital materials that provide students with opportunities to conduct research, collect data, and analyze and present their findings. While DS enable students to learn about a topic, they also give students opportunities to think and learn about their own lives (Kim & Li, 2021).

Literature Review

Studies have shown that DS used as learning materials contribute positively to the educational development of students and that they can be used to improve motivation (Başar, 2022; Hung et al., 2012; Kim & Li, 2021; Niemi et al., 2018; Korukluoğlu & Toy, 2022), creativity (Demirbaş & Şahin, 2023; Kim & Li, 2021; Özen & Duran, 2021), identity development (Kim et al., 2021), academic achievement (Başar, 2022; Korukluoğlu & Toy, 2022; Hung et al., 2012), class participation (Özen & Duran, 2021; Saritepeci, 2021), peer communication (Korukluoğlu & Toy, 2022), technological competence (Heo, 2009; Shinas & Wen, 2022), and problem-solving (Korukluoğlu & Toy, 2022; Hung et al., 2012). There are studies in the literature on the use of DS in mathematics education. For instance, Niemi et al. (2018) explored how DS are perceived by middle school students. They concluded that DS used in mathematics courses contributed to students' collaborative learning, the ability to generate new ideas, success in group work, and the ability to relate mathematics to daily life. Istenic-Starčič et al. (2016) found that DS increased students' mathematical problem-solving competencies, while Yilmaz and Siğirtmaç (2023) found that preservice teachers considered DS as a more important type of material than printed course materials because they provide both auditory and visual richness. Islim et al. (2018) showed that preservice teachers believed that DS are effective materials that can be used in mathematics courses. Kim et al. (2021) indicated that DS provide teachers and students with the opportunity to feel more confident and express their thoughts more easily. Çetin (2021) revealed that DS contribute positively to learning environments but also found that preservice teachers had difficulties in creating DS. Similarly, Özpınar (2017) found that preservice teachers mostly encountered technical issues in the process of creating DS and had difficulty in creating stories. The study emphasized that the creation of DS should be learned during the teaching process. Aldemir-Engin (2022) reported that preservice mathematics

teachers ignored the step of dramatic questions while creating their DS, did not use music, and experienced difficulties in making audio recordings and adding sound to their stories. Büyükkarcı and Müldür (2022) conducted their research with preservice mathematics teachers and showed that the actions and strategies used by preservice teachers in the process of creating DS were quite limited and that they did not complete the stages of DS creation in their entirety.

Aim of the Study

In the context of Turkish education, the mathematics curriculum gives importance to technology-supported mathematics teaching (Ministry of National Education [MoNE], 2018). Therefore, mathematics teachers are expected to use technology effectively. However, studies show that the level of mathematics teachers' use of technology for teaching purposes is not sufficient (Birgin et al., 2020) and that teachers have some deficiencies in developing digital course materials (Birgin et al., 2020; Turgut & Aslan, 2021; Walters et al., 2018). In the literature, it is emphasized that DS can be effective teaching tools for mathematics courses (Batur & Çakıroğlu, 2023), but the studies to date on the process of creating DS in mathematics education are not sufficient (Chang & Chu, 2022; Wu & Chen, 2020). It has been stated that the findings of studies conducted with limited sample groups cannot be generalized (Büyükkarcı & Müldür, 2022; Islim et al, 2018; Kocaman-Karoglu, 2016) and that such studies should be repeated with different sample groups (Yilmaz & Durak, 2018; Istenic-Starčič et al., 2016; Mojtahedzadeh et al., 2021). Furthermore, it is emphasized that little is known about the effects of DS (Stenhouse & Schafer, 2019) and that preservice teachers should work in cooperation in the process of creating DS as digital materials (Çetin, 2021). For these reasons, further research on DS is worth pursuing (Chang & Chu, 2022). There is a gap in the literature in terms of studies investigating the experiences of preservice teachers with the use of DS as digital materials in mathematics courses. It is thought that the opinions of preservice teachers who will be mathematics teachers in the future about the use of DS as digital materials in mathematics courses are important. Thus, the present study is expected to provide a contribution to the literature in terms of preservice teachers' experiences in creating DS and present insights into the use of DS as digital materials in mathematics courses.

This study aims to evaluate the DS created by preservice elementary mathematics teachers as digital teaching materials and to examine their views on the process. In this context, the study seeks answers to the following questions:

1.What is the general framework of the DS created by preservice teachers for mathematics teaching?

2.What are the opinions of preservice teachers about creating DS?

3.What are the opinions of preservice teachers about the use of DS as digital teaching materials in mathematics courses?

Method

The study was designed as a case study, employing a qualitative research method. Qualitative research focuses on how people experience phenomena and how they interpret, perceive, and construct what they experience (Merriam & Tisdell, 2015).

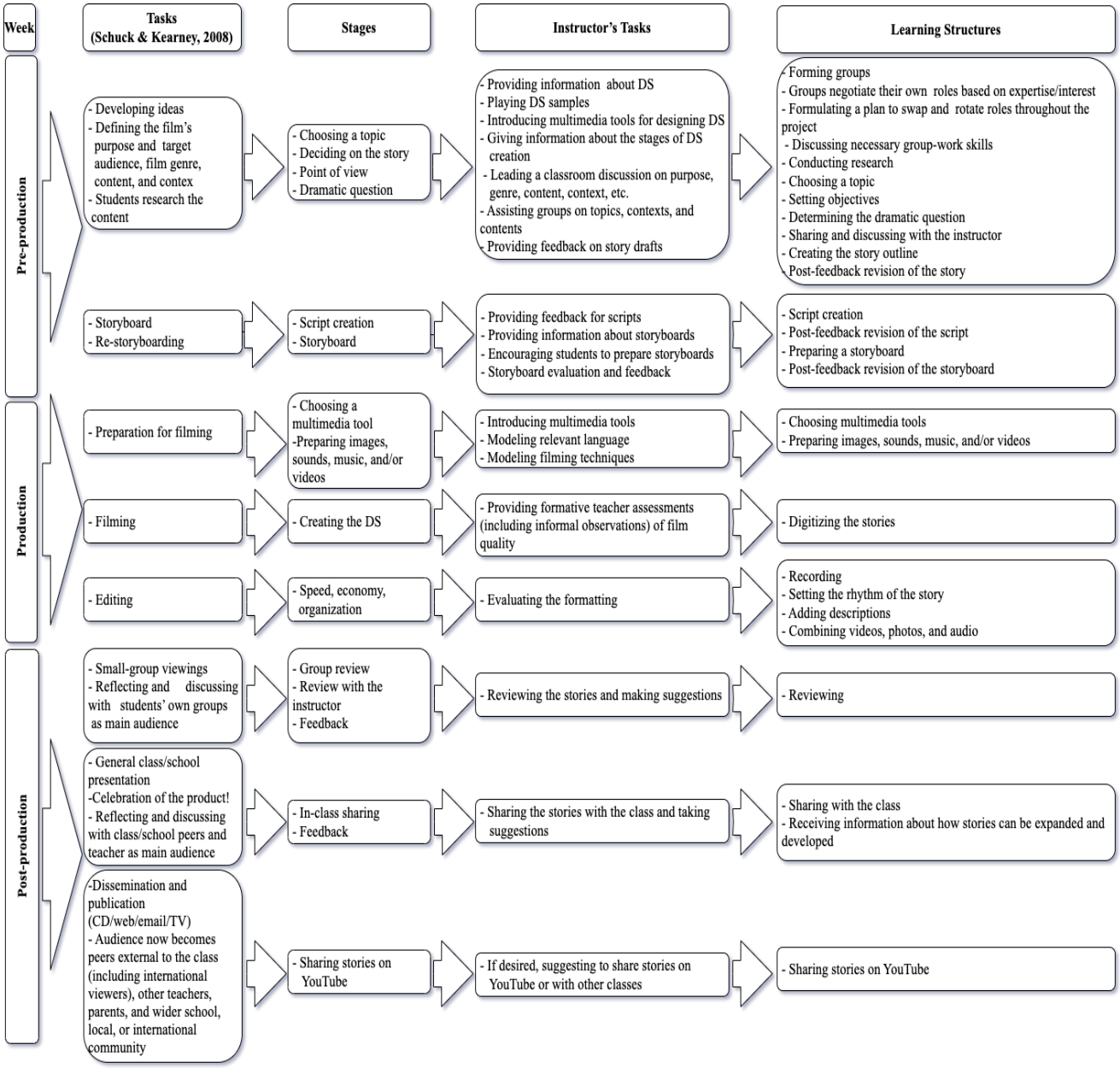
Participants of the Study

Forty-nine undergraduate preservice teachers enrolled in the Department of Elementary Mathematics Teaching at a university in the central region of Turkey participated in this study. While 78% (n=38) of the participants were female, 22% (n=11) were male. Convenience sampling from the purposeful sampling method was used to select the participants. The participants were between the ages of 19 and 24 (Mean=21.49, SD=0.12) years and they stated that they had no experience in creating DS before the implementation of this study. The data of the study was collected in the spring semester of 2022-2023.

Data Collection Process

This study was conducted within the scope of a course on computer-assisted mathematics teaching, which is an elective course in the Department of Elementary Mathematics Teaching. The computer-assisted mathematics teaching course is an applied course that meets for 2 hours a week. The study lasted 7 weeks. At the beginning of the study, preservice teachers attended a seminar lasting 2 lesson hours. Information about what a DS is, how and for what purpose DS are used in education, what DS multimedia tools exist, and examples of DS were given using in-class discussion and brainstorming methods. Afterwards, the participants were asked to form their own groups. A total of 21 groups were formed, comprising 3 people who wanted to work individually, 8 groups of two people, and 10 groups of three people. The study was conducted within the pedagogical framework proposed by Schuck and Kearney (2008) for video production and a design framework including the DS stages of Lambert (2013), Robin (2008), Bull and Kajder (2005), Lasica (2006), and Morra (2013). Each stage of the process proposed by Schuck and Kearney (2008) includes suggestions for teaching strategies and peer support. Thus, feedback was provided to ensure that the participating preservice teachers completed each stage of preparing digital teaching materials. Detailed information about the pre-production, production, and post-production practices of the study is presented in Figure 2.

Figure 2. Implementation process of the study



In the pre-production stage, the groups first examined the 2018 mathematics curriculum of the MoNE and decided on the grade levels and outcomes of the DS they would create. There were no limitations regarding the topics or levels of the DS. After conducting their research, the groups shared information in the classroom about how they would create their story environment, and they received feedback. They created their stories and scripts. Errors in mathematical definitions, editing mistakes, spelling mistakes, and other similar problems were corrected with cooperation among group members and the instructor. Some groups shared their stories with other groups and received their opinions. The groups created storyboards (Chung, 2007), which are visualizations of how a story will

be displayed. In the production stage, the groups selected a software program to use and created their DS. The majority of the groups preferred to use Powtoon, although some groups used Plotagon, Sony Vegas, and Canva, as well. After the production stage, the groups shared their DS with all participants in the computer lab. The topics of the DS included fractions (n=5), polygons (n=4), highest common factors/lowest common multiples (n=3), percentages (n=2), patterns and decorations (n=2), equations (n=2), natural numbers (n=1), integers (n=1), ratios/proportions (n=1), and the history of mathematics (n=1). The time duration of the created DS varied between 1.30 and 6.02 minutes, with an average duration of 3.32 minutes.

Data Collection Tools

Four different data collection tools were used in this study. The first was the Graded Assessment Scale for DS (GASDS), developed by Özcan, Kukul, and Karataş (2016). This scale was used to evaluate the DS created by the preservice teachers. The scale consists of three main themes with 14 sub-themes: 1) planning (dramatic question, purpose of the story, creating a storyboard, originality/appeal), 2) production (length of the story, economy, use of language and grammar, copyright and ethics, sound, music, multimedia quality, multimedia synchronization, editing), and 3) sharing/presentation/feedback (sharing for feedback). Scale items such as story length, copyright and ethics, and sharing for feedback are rated between 0 and 3 as poor to excellent; other scale items are rated between 0 and 3 as bad, poor, good, or excellent, respectively. The maximum score that can be obtained from the scale is 42, and the minimum possible score is 14.

The stories and storyboards that the groups prepared constituted the second data collection tool of the study, while the reports written by the groups constituted the third. During the implementation of the study, each group wrote a report about the process. In their reports, they recorded all the data related to the pre-production, production, and post-production stages as well as their feelings and thoughts about the process.

The final data collection tool used in this study was a focus group interview form. In preparing that form, the relevant literature was first reviewed, and then focus interview questions were formulated. In this context, two experts in the fields of mathematics education and educational sciences were consulted. In addition, a pilot study was conducted with two students. Based on the feedback from the students and experts, the focus interview form was finalized by removing or reorganizing questions that were difficult to understand, complex, or incompatible with the study. After the implementation process was over, a total of 8 focus group interviews were conducted in groups of 5 in the researcher's office. All participants verbally confirmed that they were participating in the interviews based on principles of voluntariness and willingness. The participants were assured that their names would be kept confidential and the data would not be shared with anyone. Interviews were audio-recorded with the permission of the participants. The interviews lasted approximately 15-20 minutes. The questions in the 9-item focus group interview form were as follows:

1.What do you think a DS is, and how would you define it?

2.What were your favorite aspects of creating a DS? Can you describe them?

3.What were the most difficult aspects of creating a DS? Can you describe them?

4.What do you think about the use of DS in mathematics courses as digital teaching materials?

5.What are the advantages and disadvantages of using DS as digital teaching materials in mathematics education?

6.Would you use DS as digital teaching materials when you become a teacher? Please explain why or why not.

7.What are your thoughts about the skills you gained from the DS creation process?

8.What would you take into consideration if you were going to create a DS as digital teaching material again? What would be your suggestions?

9.Is there anything else you would like to add?

Data Analysis

The groups' DS were evaluated separately by three field experts. Pearson correlation analysis was used to verify the validity of the experts' evaluation scores. Qualitative data were analyzed by the content analysis method. In this context, the interviews recorded as audio files were transcribed into written text. The names of the students were kept confidential, and the students were given pseudonyms in the form of P1, P2, ..., P49. After the hard copies of the written texts and the reports were read three times by two researchers, the coding stage began. The coding and categorization stages were carried out with the NVivo 9 software program. During the analysis, the codes and categories created by two different researchers were compared; codes that did not match were placed within appropriate categories or eliminated. This process continued until the inter-coder reliability score was 100%.

Validity and Reliability

It is necessary to meet the criteria of credibility and transferability to ensure validity in qualitative research and to collect evidence of reliability to ensure that the conclusions drawn from the findings are reliable. The following methods are used in order to ensure validity criteria: long-term interaction, in-depth data collection, triangulation, expert opinion, participant confirmation, detailed description, and purposeful sampling (Creswell, 2020). Throughout the process, the researcher and the preservice teachers were in constant communication. The researcher provided guidance to the preservice teachers. The participants could easily reach the researcher at every stage of the research process and receive feedback. It was also aimed at collecting diversified and in-depth data by using more than one data collection tool. Before the study began, the

participants were informed about the study and asked for their consent to participate. In order to increase the validity and reliability, expert opinions were obtained and direct quotations from participants were included. The study was initiated only after the necessary ethics committee permissions were obtained.

Findings

1. General framework of DS

The experts evaluated the DS created by the groups according to the GASDS (Table 1). The scores of the groups ranged between 16.3 and 37.3 and the average score was 27.6. 12 (57%) groups scored above the average score, 9 (43%) groups scored below the average, and 1 group scored below half of the maximum score that can be obtained from this scale. With the exception of that final group, all groups can be considered to have completed the DS preparation process at an intermediate level or above.

Pearson correlation analysis was used to ensure the validity of the scores (Table 2). Table 2 shows that there was a significant and positive relationship between Expert 1 and Expert 2 ($r=.817$, $p<.01$), between Expert 2 and Expert 3 ($r=.536$, $p<.01$), and between Expert 1 and Expert 3 ($r=.786$, $p<.01$).

Table 1: GASDS scores according to experts

	expert 1	expert 2	expert 3	Mean
Group 1	22	28	25	25.0
Group 2	35	30	29	31.3
Group 3	29	33	26	29.3
Group 4	36	29	34	33.0
Group 5	24	28	21	24.3
Group 6	26	28	23	25.6
Group 7	38	34	35	35.6
Group 8	31	35	27	31.0
Group 9	34	30	36	33.3
Group 10	35	29	31	31.6
Group 11	29	33	25	29.0
Group 12	21	24	19	21.3
Group 13	21	25	20	22.0
Group 14	18	23	24	21.6
Group 15	40	34	38	37.3
Group 16	12	17	20	16.3
Group 17	29	26	32	29.0
Group 18	29	32	28	29.6
Group 19	24	27	22	24.3
Group 20	22	26	33	27.0
Group 21	23	26	18	22.3

Table 2: Pearson correlation test results

		R		P
n		expert 1	expert 2	
expert 1	21			
expert 2	21	.817**		.000
expert 3	21	.786**	.536*	.000

2. Definitions of a DS

The participants' definitions of a DS emphasized the transfer of traditional stories to a digital environment, story creation through software programs, and materials that appeal to the senses (Table 3).

Table 3: Participants' definitions of a DS

Categories	%
Digitizing traditional stories	40
Material that appeals to the senses	35
Creating a story through a software program	30
Transferring knowledge through animation	22
Teaching material	22
Educational digital content	20
A Story in a virtual environment	12
Movie-style digital video	8

P32 defined DS as *"Stories supported by animated visuals, animations, sound, and music. These stories are created with the help of technological devices and applications. The presentation of the story is also done on smart devices and online platforms."* P16 defined DS as *"Transforming a verbally written story into a material that appeals to more senses with visual scenes and voiceovers."*

3. Experiences related to the DS creation process

Participants expressed their opinions about the situations they liked and found difficult during the DS creation process (Figure 3).

Figure 3. What the participants liked and found difficult in the DS creation process

a)Likes

In describing what they liked about the process of creating a DS, 61% of the participants stated that their favorite aspect was doing voiceovers using their own voices. P22 stated: *"It was a lot of fun because we did the voiceover part ourselves. Instead of using ready-made voices, we created a more original DS."* In the words of P12: *"The part I enjoyed the most was that I was able to use my own appearance and my own voice in the DS. I was the writer, screenwriter, director, and actor of that DS. In short, I was happy to voice and create my own character and to have something from me in the story."* P4 said: *"I enjoyed the part of creating speech bubbles and writing a script the most. While explaining the subject, I enjoyed it, as if I was explaining it to a student."* Regarding the multimedia tool they used, 49% of the participants stated that they liked that it offered rich contents, 29% liked that it had a simple interface, 34% liked that it allowed them to choose characters, and 23% liked that it allowed them to upload content. P35 said: "It was quite fun to create the characters. We made them ourselves, from the shape of their jaw to the color of their socks."

Furthermore, 57% of the participants stated that creating a DS through group work contributed positively to their personal skills. While 51% stated that it contributed positively to their communication skills, 34% stated that it contributed positively to their problem-solving skills. P1 said: *"Since we worked as a group, different ideas emerged and we tried to make a common decision. The division of labor enabled us to finish the work in a planned and timely manner."* In the words of P9: *"Most importantly, I think it contributed to our problem-solving skills, because we had to fictionalize an event and produce practical solutions to the problems created by the program, and it enabled us to deal with the problems we encountered."*

Additionally, 20% of the participants stated that creating a DS increased their self-confidence. Some participants who initially did not think that they could create a DS said that they were happy to create digital materials successfully and that it increased their self-confidence. P22 said: *"Being able to create something mathematical in a digital environment gave me the confidence to create my own materials when I become a teacher, although I was not afraid of such practices before this course."*

Finally, 49% of the participants stated that creating a DS improved their skills in technology. P16 said: *"I learned that I can create content for mathematics courses. I realized that I can easily use most of the apps while preparing digital content."* 35% of the participants stated that writing a script was a positive aspect of creating a DS and 16% noted that they enjoyed adding originality to their stories.

b) Difficulties

Along with the aspects they liked, participants also provided information about some of the difficulties they faced. Most significantly, 56% of the participants stated that the necessity of paid subscriptions made the DS creation process difficult. The content, time, and sharing limitations that paid software set for users who used the free options of the software made the process of creating DS more difficult. Some participants reported that they even had to find different ways to download the videos. P33 said: *"Some of the features were with charges. We had to shorten the dialogues because only a short duration of like three minutes was free."* In the words of P36: *"The most difficult part was finding a background and adding characters, because the [free] backgrounds in the app were not what we wanted. Characters couldn't be added, because that option had a fee. We had to search for them all ourselves, download them, return to the app, and add them."* Furthermore, 25% of the participants stated that they had difficulty because the free parts of the software program had insufficient content.

50% of the participants stated that they had difficulty in adjusting the synchronization of sound, image, dialogue, and duration. P28 said: *"We used paid software and it gave us the right to use it for free just for a certain period of time. Since we recorded and added the sounds all at once, not scene by scene, there were scene and sound mismatches. It was quite difficult to adjust them."* P4 explained: *"We had difficulty in adjusting the sound*

and duration." Finally, in the words of P18: *"We had difficulty in adjusting the transition time of visuals and dialogues."*

Among other difficulties described by the participants, 22% stated that they had many problems when they first started using the software. P34 explained: *"We had difficulty in the process of learning the program while creating a DS. We were using a software program that we didn't know and had no experience with."* Similarly, P3 said: *"We had a lot of difficulty in using the software program because we were working on an app that we had never used before."*

While 37% of the participants stated that one of the most difficult aspects of creating a DS was doing voiceovers, 15% also stated that it was difficult to write a script, 2% had difficulty adding originality to the story, and 2% struggled in establishing a connection with daily life. For example, P10 stated: *"We had difficulty in determining the topic and preparing a script. The reason for this was the effort to choose the most appropriate topic that we could adapt to a DS from among many topics." In the words of P9: "I can say that we had difficulty in the script-writing process. We tried so hard to write a different story, to establish a connection with daily life and to add originality to the story."*

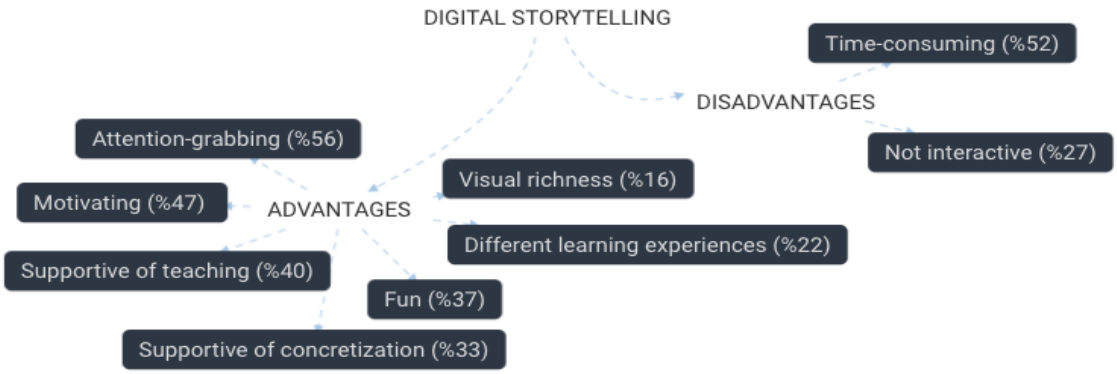
Furthermore, 12% of the participants stated that they had difficulty in creating backgrounds, 10% in adding sound effects, 8% in making speech bubbles, 8% in choosing a scene, and 8% in creating background music, while 20% of the participants reported difficulties due to technological deficiencies, such as not having a personal computer or having trouble with the internet.

4. DS as digital materials

While 86% of the participants stated that they would like to use DS as digital materials when they start working as mathematics teachers, 37% of the participants specified that they would prefer to use ready-made DS instead of creating them themselves. On the other hand, 14% of the participants stated that using DS was unnecessary and a waste of time.

Participants were asked to express their opinions about the advantages and disadvantages of using DS as digital materials in mathematics courses (Figure 4).

Figure 4. Advantages and disadvantages feature of using DS as digital teaching materials



a) Advantages

Among the advantages of DS, 56% of the participants stated that they are interesting course materials, 47% stated that DS can be used as motivational tools, 40% stated that DS can be used as materials to support teaching, 37% stated that DS can be fun materials for students, and 16% stated that they offer visual richness. Finally, 22% of the participants felt that DS can offer different learning experiences to students. P37 explained: *"We knew how to use various geometry software programs, but we've seen that DS can be used as teaching materials as well."* P14 stated: *"I never thought that DS could be used for a mathematics course before."* In the words of P18: *"I never thought that mathematics and mathematical concepts could be explained with stories other than daily-life questions. It broadened my perspective and made me look at teaching concepts from a different point of view."*

b) Disadvantages

As the most commonly described disadvantage, 52% of the participants stated that the time it takes to create a DS is an important obstacle to their use as digital materials. P2 shared the following opinion: *"When I start to work as a teacher, I would like to use DS in my courses. However, the preparation process is a laborious one that takes a lot of time, so I would use ready-made DS instead of creating them myself."* Furthermore, 27% of the participants stated that DS are not interactive materials. For this reason, they said, DS may not attract the interest of all students or they may be boring materials for some students.

5. Suggestions for creating DS

While 42% of the participants stated that the purpose should be clearly determined before starting to create a DS, 24% said that the integrity of the story and the perception of reality should not be disturbed. As other suggestions, 32% of the participants emphasized that it is necessary to research the features of the software to be used before

beginning to create a DS, 15% of the participants said that they would have preferred software with a Turkish-language interface, 18% felt that more attention should be paid to voiceovers, and 12% emphasized that there should be more animated visuals.

Results and Discussion

In this study, the DS developed by preservice mathematics teachers as digital teaching materials were evaluated. In line with the findings obtained from focus group interviews and reports, the participants' experiences related to the DS creation process and their views on the use of DS as digital teaching materials in mathematics courses were examined.

A total of 21 DS were created in this study. The average score of the DS as evaluated by experts was 27.6, and 57% of the groups scored above the average score. This shows that the DS created by the groups were moderately acceptable. However, the score of one group was very low. This result differs from the findings of the study conducted by Çetin (2021), as the DS (75%) created by the preservice computer science teachers who participated in that study were highly successful. It is thought that this difference may be related to the participants' specific fields of education. In Korukluoğlu and Toy's (2022) study, it was determined that the students performed well in the DS preparation process and at a moderate level in the DS creation process.

The definitions of a DS provided by the preservice teachers who participated in this study were dominated by expressions of transferring traditional stories to a digital environment and creating stories using software. The participants characterized DS as teaching materials and defined them as materials that appeal to the senses. Nunvářová et al. (2022) stated that there is no single definition of a DS because there are different possible versions of DS. Although there are different definitions of DS, these definitions are generally centered around the idea of integrating information-sharing and storytelling into technology (Yilmaz & Durak, 2018).

One of the essential stages of DS preparation is the creation of the content. While most of the participating preservice teachers stated that they were satisfied with being able to add originality to the script and the story, some participants had difficulty in preparing the script, adding originality to the story, and establishing a connection between the story and daily life. The related literature indicates that preservice teachers often have difficulties in selecting a topic, planning the story, and writing the script among the stages of DS preparation (Çetin, 2021; Özpınar, 2017). Ciğerci and Yıldırım (2023) stated that individuals who are successful in story-writing are more successful in creating DS. If the person who writes the story is satisfied with the story, the other stages progress more easily. In this regard, one may argue that preservice teachers need support in writing stories or preparing scripts.

The participants of the present study had no previous experience in preparing DS. One of the positive results of this study is that some preservice teachers who did not initially believe that they could prepare digital content regained their self-confidence in the course of creating and sharing DS. Sarıtepeci (2021) stated that DS used in learning environments increase students' self-confidence and provide opportunities for them to discover their interests and abilities. Creating a DS is not as complex a process as teachers and students typically think (Kobayashi, 2012). Preservice teachers similarly need to realize that using software that they perceive as complex is not as complicated as they think.

The participating preservice teachers developed their technological competencies while creating DS. In the literature, there are studies emphasizing that digital materials improve students' technological competencies (Niemi et al., 2018; Nunvářová et al., 2022; Kobayashi, 2012; Korukluoğlu & Toy, 2022; Özpınar, 2017; Sadik, 2008; Saritepeci, 2021; Smeda et al., 2014; Shinas & Wen, 2022). If appropriate environments are provided, students can use technology effectively (Sadik, 2008). As other outcomes of the present study, the preservice teachers developed skills related to communication, group work, and research while creating their DS. There are studies in the literature showing that DS contribute positively to various skills of students. Istenic-Starčič et al. (2016) showed that preservice teachers who created DS moved from being passive recipients to active producers. Niemi et al. (2018) found that DS encouraged students to learn new technologies and contributed to the development of mathematical literacy and 21st-century skills. The study by Korukluoğlu and Toy (2022) showed that creating and presenting their own stories contributed to students' abilities to work collaboratively. In addition, it was stated that creating DS allowed the students to conduct more research on subjects they were curious about.

In this study, the preservice teachers stated that DS support the teaching of mathematics and contribute to it through concretization. Previous studies similarly indicated that DS have the potential to contribute to teaching through concretization and support meaningful learning (Başar, 2022; Korukluoğlu & Toy, 2022; Robin, 2008; Saritepeci, 2021; Smeda et al., 2010, 2014; Yilmaz & Sığirtmaç, 2023). Some students need concretization to make sense of mathematics. Explaining abstract concepts with the help of digital content facilitates the teaching process and helps students make sense of mathematics. Goral and Gnadinger (2006) noted that some children have difficulty understanding concepts even with the help of manipulative tools. The fact that stories appeal to students' imaginations and emotions facilitates learning. Thus, the use of DS in mathematics teaching can be considered as a way to help students make sense of abstract concepts.

Moreover, DS are interesting and entertaining digital materials that can be used as motivational tools at the beginning of a course and provide students with different learning experiences in mathematics courses. Similarly, previous studies indicated that DS are interesting and fun digital learning materials (Korukluoğlu & Toy, 2022; Özen & Duran, 2021; Özüdoğru & Çakır, 2020). Yilmaz and Sığırtmaç (2023) emphasized that

DS appeal to the visual and auditory senses, enrich learning environments, and, therefore, are materials that attract children's attention.

The present study shows that DS are digital materials that can be used in mathematics courses. The majority of the participants stated that they would like to use DS in their classes when they become teachers. Similarly, Smeda et al. (2014) showed that teachers have positive attitudes toward using DS as teaching materials in their classes. Furthermore, it was found that teachers who used DS in their classrooms fulfilled their mentoring responsibilities better and carried out the learning process effectively. However, it takes time to create a DS. According to the participants of the present study, the primary disadvantage of creating a DS is that it is time-consuming. Nunvářová et al. (2022) stated that due to the time-consuming nature of creating DS, they are not widely used in practice. Similarly, it has been emphasized in various studies that one of the negative aspects of creating a DS is that the preparation process takes time (Islim et al., 2018; Yilmaz & Siğirtmaç, 2023; Özpınar, 2017; Özüdoğru & Çakır, 2020; Sadik, 2008; Turgut & Aslan, 2021). The fact that it takes time to create a DS suggests that preservice teachers may prefer using ready-made digital materials when they start working. This finding differs from the results of some studies in the literature (Islim et al., 2018; Özpınar, 2017). In a study conducted by Islim et al. (2018), it was found that preservice teachers were willing to prepare their own DS when they started working. Similarly, Kobayashi (2012) found that preservice teachers had positive feelings about DS and intended to use them with their students. However, Nunvářová et al. (2022) reported that although students were satisfied with DS, they preferred traditional learning methods. This finding further supports the conclusion that preservice teachers may prefer to use ready-made DS instead of their own DS when they start working because the preparation process is laborious and time-consuming. When teachers do not have the competence and time to create their own digital materials, they tend to use ready-made materials. However, they often face difficulties in finding ready-made materials suitable for the subject and grade level (Turgut & Aslan, 2021).

Another stage of creating a DS is technology integration. It was observed in this study that preservice teachers had difficulties in technological integration. The participants faced challenges due to the use of multimedia tools. These findings are in line with the relevant literature. Özüdoğru and Çakır (2020) stated that preservice teachers had problems using software. Walters et al. (2018) emphasized that preservice teachers raised in the digital age use the communication and entertainment functions of technology and are not familiar with the educational implementations of hardware and software. The participating preservice teachers had difficulties in various stages of the DS creation process, struggling with issues such as voiceovers, synchronization, limited available content, and the need to decode the language of the software. Korukluoğlu and Toy (2022) also found that teachers had difficulties in technical areas such as voiceovers, music, and the use of interesting and original multimedia tools in the creation of DS. However, the biggest difficulty can be said to be the limitations of paid software. For this reason, the participants of the present study stated that it is necessary to know the features of the software program in advance and create a DS accordingly. Similarly,

Büyükkarcı and Müldür (2022) stated that the limited free features of software programs negatively affected the DS creation process.

In this study, the preservice teachers had great difficulty in the voiceover process while creating their DS. At the same time, voiceovers were among their favorite aspects of the process. Although they stated that they faced many challenges while creating the DS, they also said that they found ways to deal with those difficulties. This shows that the participating preservice teachers improved their problem-solving and communication skills. These results are in line with the findings of studies in the literature. It has been emphasized in various studies that DS make positive contributions to students' problem-solving and communication skills (Büyükkarcı & Müldür, 2022; Çetin, 2021; Korukluoğlu & Toy, 2022; Hung et al., 2012; O'Byrne et al., 2018). Creating DS helps preservice teachers reach the desired results by generating their own solutions to the problems they encounter.

Conclusion and Suggestions

Based on the findings of this study, it can be concluded that preservice teachers have positive opinions about the use of DS as digital materials in mathematics courses. The fact that the preservice teachers realized that DS are digital materials that can be used in mathematics courses is one of the positive results of the study. Creating DS requires that story-writing and technology use be carried out together. In this sense, it can be said that preservice teachers need experience in both writing stories and using technology for instructional purposes. In the future, the effects of studies conducted by researchers working in different fields such as language, computer science, and mathematics in the process of creating DS could be investigated. Preservice teachers are generally acquiring the necessary competencies to produce digital contents to be used in mathematics education only through elective courses during the course of their education process. It is argued that DS, which are digital materials, should be integrated into course curricula (Kim & Li, 2021; Kobayashi, 2012; Yilmaz & Sığirtmaç, 2023). In order to use DS effectively in educational environments, preservice teachers should be given opportunities to develop digital materials with high-quality training before completing their undergraduate programs.

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Genişletilmiş Türkçe Özet

Teknolojik gelişmeler eğitim ortamında dijital materyallerinin kullanılmasını mümkün kılmaktadır. Dijital materyaller eğitimci ve öğrencilere bilgi ve becerilerini geliştirme imkânı sunmakta, dolayısıyla eğitim standartlarının yükselmesine fırsat sağlamaktadır (Smeda ve ark., 2014). Özellikle Covid 19 sonrası dijital materyallerin öğrenmeye olan katkısı giderek önem kazanmaya ve kullanımı konusunda daha bilinçli olmaya başlanmıştır. Dijital materyallerin yelpazesi oldukça geniştir. (Schneider ve ark., 2022). Eğitimde kullanılan dijital materyallerinden biri dijital hikayelerdir (DH). DH çoğunlukla sanat ve beşerî bilimler ile ilişkilendirilmiş olsa bile matematik gibi sayısal derslerde etkili bir öğretim materyali olarak kullanılabilir (Sadik, 2008; Wu & Chen, 2020).

DH, belli bir konudaki hikâyenin dijital ortamda sunulması (Çetin, 2021; Kobayashi, 2012) başka bir ifade ile çoklu ortam araçları kullanarak hikâyenin zenginleştirilmesidir (Yilmaz & Durak, 2018). DH kavramı, hikâye anlatma sanatını resim, ses ve video gibi çeşitli dijital multimedya ile birleştirme fikrine dayanır. Teknoloji kullanarak belli bir konu hakkında bilgi sunmak için metin, ses, video, grafik ve müziğin bir araya getirilmesidir (Chung, 2007; Robin, 2006, 2008; O'Byrne ve ark., 2018). DH bireylerin duygu ve düşüncelerini aktarmaya (Kocaman-Karoglu, 2016; Ng, 2015) ya da karmaşık kavramları hem dilsel hem de dilsel olmayan yollarla iletmeye yarayan araç olarak tanımlanabilir (Kim & Li, 2021; Kim ve ark., 2021).

DH geleneksel hikâye oluşturma fikrine dayanır bu nedenle aralarında benzer ve farklı noktalar bulunmaktadır. DH ile geleneksel hikâye arasında fark ise, DH'nin, çeşitli dijital multimedya araçları tarafından desteklenmesidir (O'Byrne ve ark., 2018). Sınıf ortamında teknoloji etkinliğini artırmak için kullanılan DH'lere yönelik teorik bir çerçevenin net olarak ortaya konduğu söylenmez (Robin, 2008; Smeda ve ark., 2010). Genel olarak, DH'leri hazırlama süreci iki boyuttan oluşmaktadır. İlk boyut bağlam çerçevesinde hikâye ve buna bağlı olarak senaryo aşaması diğer boyut senaryo çerçevesinde gerçekleşen teknoloji entegrasyonunu kullanma aşamasıdır (Saritepeci, 2021; Wang & Zhan, 2010; Büyükkarcı & Müldür, 2022). Literatürde DH hazırlama sürecini farklı araştırmacılar farklı boyutlar altında toplamıştır. Robin (2008), Center for Digital Storytelling (2005) tarafından belirlenen yedi unsuruna odaklanmaktadır. Bu unsurlar DH üzerine çalışmak için bir başlangıç kabul edilen DH'nin yedi elementini oluşturmaktadır. Cennamo ve ark. (2010) ise DH oluşturma sürecini beş aşamada tasarlamıştır. Lasica (2006) DH unsurlarını daha geniş kapsamda oluşturarak on aşamalı bir süreçten bahsetmektedir.

İnsan yaratıcılığı ve teknolojinin harmanlanması ile oluşturulan DH'ler öğrenci merkezli, etkileşimli öğrenme ve öğrenmeyi teknoloji açısından zengin ortamlara aktarabilen materyaller olarak nitelendirilmektedir (Smeda ve ark., 2014). Bu nedenle, DH'ler öğretmen ve öğrencilere teknolojiyi etkin bir şekilde kullanma fırsatı sunmaktadır (Robin 2006, 2008). Barrett (2006) DH'lerin katılım, derin öğrenme, proje tabanlı öğrenme ve teknoloji entegrasyonu olmak üzere dört öğrenci merkezli öğrenme stratejisini kolaylaştırdığını belirtmektedir. Bunun yanı sıra, eğitimde kullanılan DH'nin bireylerin

bilgi toplama, problem çözme becerisi, eleştirel düşünme ve estetik duyarlılık geliştirme konusunda teşvik edici bir araç olduğu görüşü hakimdir (Chung, 2007; Çetin, 2021; Kim ve ark., 2021; McLellan, 2007; Yilmaz & Durak 2018; Walters ve ark., 2018).

Bu çalışma, ilköğretim matematik öğretmen adaylarının dijital öğretim materyali olarak tasarladıkları DH değerlendirmek ve sürece ilişkin görüşlerini incelemeyi amaçlamaktadır. Bu bağlamda, araştırma aşağıdaki sorulara cevap aramaktadır.

1. Öğretmen adaylarının matematik öğretimi için geliştirdikleri DH'lerin genel çerçevesi nedir?

2. Öğretmen adaylarının DH tasarlamaya yönelik görüşleri nelerdir?

3. Öğretmen adaylarının matematik derslerinde dijital öğretim materyali DH'lerin kullanımına yönelik görüşleri nelerdir?

Araştırma nitel olarak tasarlanmıştır. Nitel araştırma, kişilerinin yaşadıklarını nasıl deneyimledikleri, yorumladıkları, algıladıkları, nasıl yapılandırdıklarına odaklanmaktadır (Merriam & Tisdell, 2015). Araştırmaya, Türkiye'nin iç bölgesinde bulunan bir üniversitenin ilköğretim matematik öğretmenliği bölümüme devam eden 49 lisans düzeyinde öğretmen adayı katılmıştır. Katılımcıların %78 (38)'i kız, %22 (11)'i erkektir. Katılımcıların seçiminde amaçlı örnekleme yöntemi kullanılmıştır. Araştırmada dört farklı veri toplama aracı kullanılmıştır.

Araştırmada toplam 21 DH hazırlanmıştır. Uzmanlar tarafından değerlendirilen DH'lerin ortalama puanı 27.6 olarak belirlenmiştir. Grupların %57'si ortama puanın üstünde puan almıştır. Bu oran grupların oluşturduğu DH'lerin orta düzeyde kabul edilebilir olduğunu göstermektedir. Bir grubun puanı ise oldukça düşük seviyede kalmıştır. Araştırmanın bu sonucu Çetin (2021)'in çalışması ile farklılaşmaktadır. Çetin (2021)'in çalışmasına katılan bilgisayar öğretmen adaylarının oluşturduğu DH (%75) yüksek düzeyde başarılı olmuştur. DH hazırlanın temel aşamalarından biri içerik kısmının oluşturulmasıdır. Öğretmen adayların çoğu senaryo ve hikâyeye özgünlük katabilmekten dolayı memnun olduklarını belirtirken bazı katılımcılar için senaryo hazırlama, hikâye özgünlük katmak ve hikâyenin günlük hayatla bağlantısını kurmakta oldukça zorlanmışlardır. İlgili literatürde öğretmen adaylarının DH konu seçme, hikâye yazma, senaryo yazma aşamalarında zorlandıklarını göstermektedir (Çetin, 2021; Özpınar, 2017). Ciğerci ve Yıldırım (2023) hikâye yazmada başarılı olan bireylerin DH yaratmada daha başarı olduklarını belirtmektedir. Hikâyeyi yazan kişi hikayesinden memnun ise diğer aşamalar daha kolay ilerlemektedir. Öğretmen adayları, DH tasarlarken teknoloji konusundaki yetkinliklerini geliştirmişlerdir. Literatürde, dijital materyallerin öğrencilerin teknolojik yetkinliklerini geliştirdiği vurgulayan araştırmalar mevcuttur (Niemi ve ark., 2018; Nunvářová, ve ark., 2022; Kobayashi, 2012; Korukluoğlu & Toy, 2022; Özpınar, 2017; Sadik, 2008; Saritepeci, 2021; Smeda ve ark., 2014; Shinas & Wen, 2022). Uygun ortamlar sağlandığı takdirde öğrenciler teknolojiyi etkin bir şekilde kullanabilmektedir (Sadik, 2008). Araştırmanın bir diğer sonucu ise öğretmen adaylarının DH tasarlarken iletişim, grup çalışması, araştırma

yapma becerilerini geliştirdiğidir. Literatürde DH'lerin öğrencilerin çeşitli becerilerine olumlu katkılar sağladığını gösteren araştırmalar mevcuttur. Istenic-Starčič ve ark. (2016) çalışması DH tasarlayan öğretmen adaylarını pasif alıcı konumundan aktif üretici konuma geçtiğini göstermektedir. Niemi ve ark. (2018) çalışması DH'nin öğrencileri yeni teknolojiler öğrenmeye teşvik ettiği, matematik okuryazarlık ve 21. yüzyıl becerilerinin gelişimine katkı sağladığını göstermektedir. Korukluoğlu ve Toy'un (2022) çalışması ise öğrencilerin kendi hikayelerini oluşturması ve sunmasının iş birliği içinde çalışma becerilerine katkı sağladığını göstermektedir. Ayrıca DH oluşturmanın öğrencilerin merak ettiği konuda daha fazla araştırma yapmasına olanak sağladığı belirtilmiştir.

Ethics Committee Approval: This research received ethical approval from the Social and Humanities Ethics Committee at Yozgat Bozok University, as per decision number 38/14, dated 16.11.2022

Informed Consent: Informed consent was obtained from all individual participants included in the study.

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Mathematical Thinking and Learning in Early Childhood: A Consolidated Qualitative Synthesis of Cutting-Edge Research Literature

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Abstract: The primary goal of this study is to synthesize current research on early childhood mathematical thinking and learning, focusing on cognitive development, instructional strategies, and environmental influences. The study provides a comprehensive qualitative analysis, integrating diverse theoretical frameworks and recent empirical findings for a nuanced understanding of early math education. Methodologically, the study systematically reviews peer-reviewed studies published between 2013 and 2024, employing thematic synthesis to identify patterns and themes. Key stages included coding, developing descriptive themes, and generating analytical themes. The primary outcomes highlight the significant impact of play-based learning, interdisciplinary approaches, and parental involvement on early mathematical development. Additionally, the study underscores the role of technology and supportive learning environments in enhancing children's math skills. Conclusions emphasize the importance of holistic and culturally responsive educational practices. The practical implications provide valuable insights for educators, policymakers, and researchers aiming to improve early childhood math education.

Keywords: Early Childhood Mathematics, Playful Learning Strategies, Cognitive Development, Technology and Environmental Influences, Home Environment in Early Mathematics, Parental Attitudes Towards Mathematics, Cognitive Predictors of Early Mathematics.

About the Article

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Introduction

Background and Significance

Early childhood mathematical thinking is foundational for academic success and cognitive development. Research emphasizes the long-term significance of early math skills for future academic achievements. Claessens and Engel (2013) demonstrated that these foundational skills are integral to later academic success, and Fisher et al. (2012) similarly noted the predictive role of early math abilities, including literacy, for cognitive development. This body of research suggests that preschoolers' interest in math acts as a strong indicator of future mathematical competence (Ribner et al., 2017). Moreover, executive function, which includes skills like working memory and cognitive flexibility, has been shown to mitigate the relationship between early math skills and subsequent academic performance, emphasizing the value of cognitive and socioemotional development in young learners (Isbell et al., 2019).

Further studies expand on the diverse predictors of mathematical reasoning in adolescence. Cortes et al. (2022) found that early fine motor skills are precursors to visuospatial deductive reasoning, illustrating how physical developmental milestones support cognitive advancements in mathematics. Similarly, Gashaj et al. (2022) indicated that the home environment, parenting style, and children's innate abilities contribute significantly to early math skill formation. Educators are advised to foster diverse opportunities for spatial concept exploration, as spatial reasoning is fundamental for understanding and interacting with the world, which Deans and Cohrssen (2015) highlight as crucial for children's mathematical development.

Research also shows a direct relationship between various cognitive skills—such as working memory, primary numeracy, and spatial skills—and later math anxiety and performance in adulthood (Douglas & LeFevre, 2018). Isbell et al. (2019) further emphasize that cognitive functions like conflict monitoring and control skills are tied to emerging academic abilities in early childhood through primary school years, while inhibitory control established in preschool correlates with math proficiency in first grade (Ng et al., 2015). These findings collectively underscore the impact of cognitive predictors, with Vasilyeva (2019) noting that executive function and intelligence together shape young children's development of symbolic number skills, foundational for more complex math understanding. Moreover, Cohrssen et al. (2016) observed that play-based math activities shape educators' positive attitudes toward teaching math, thus supporting more engaging and effective math instruction.

The home environment and intergenerational patterns also affect early math learning, as Bernabini et al. (2020) documented. These factors, combined with cognitive and linguistic skills, support young children's early math abilities, while regular home math activities directly relate to four-year-olds' math skills (Leyva et al., 2021). Similarly, the interplay between math and behavioral skills is evident in early childhood, as demonstrated by Fisk and Lombardi (2021).

The influence of math anxiety on children's engagement in math activities is also significant, indicating a need for targeted interventions that can reduce stress and foster a positive math learning environment (DePascale et al., 2023). Play-based math activities not only shape educators' attitudes but also instill positive perceptions toward mathematics, providing a foundation for children's engagement and learning (Cohrssen et al., 2016). Furthermore, bilingual math instruction, involving code-switching, reveals important insights into the influence of language on math learning (Prabowo & Ambarini, 2022). The integration of interactive media into math instruction enhances learning by making abstract concepts more accessible (Journal et al., 2018). For instance, Breive (2022) presents new perspectives on children's mathematical conceptualization, challenging traditional approaches to abstraction, while Bakar and Karim (2019) highlight the role of visualization and multiple representations in developing mathematical understanding.

Parental attitudes also significantly shape early childhood math development. Positive parental engagement in math activities has been associated with enhanced mathematical skills in children, underscoring the need for a supportive home environment that fosters numeracy. Eason and Ramani (2018) report that parents' positive attitudes toward math are linked to greater child engagement in math-related activities, enhancing math achievement. Zippert and Ramani (2016) further emphasize the importance of parents' understanding of their children's numerical abilities, which is instrumental in optimizing developmental math experiences.

Parental math anxiety, however, poses challenges to children's math learning. Research shows that math-anxious parents may hinder their children's progress by negatively impacting homework interactions (Poisall, 2023; Oh et al., 2022). Maloney et al. (2015) found that math-anxious parents tend to engage in less effective math-related interactions, increasing children's math anxiety and lowering achievement levels. This suggests that while parental involvement generally supports children's learning, the quality of engagement—supportive and constructive rather than anxiety-driven—remains crucial (Retanal et al., 2021).

Furthermore, the home math environment extends beyond the frequency of math activities to encompass parents' beliefs and expectations regarding math learning. Keyser et al. (2020) argue that parental expectations profoundly influence early cognitive outcomes, highlighting how a nurturing home environment can offer valuable learning opportunities before formal education begins. In support, Oh et al. (2022) suggest that autonomy-supportive parental involvement can counteract the effects of parental math anxiety, thereby enhancing children's math achievement.

Cultural and socio-economic contexts also shape parental attitudes toward children's math learning. Daucourt et al. (2021) found that parents from lower socio-economic backgrounds might underestimate their children's math potential, leading to lower expectations and potentially poorer outcomes. This highlights the need for interventions that educate parents on the importance of their attitudes and involvement, particularly

across diverse socio-economic settings (Pan et al., 2022). Such an approach underscores the importance of fostering positive parental attitudes toward math, addressing parental anxiety, and educating parents on effective involvement strategies, essential steps for optimizing early math learning experiences and promoting equitable educational outcomes.

This study synthesizes existing research to create a cohesive framework that informs early childhood math education practices. Integrating aspects of pedagogy, language, and instructional media offers a holistic approach to advancing the teaching and learning of foundational mathematical concepts. The synthesis demonstrates the impact of early math thinking on children's academic success and cognitive development, underscoring the interconnected roles of cognitive abilities, socioemotional skills, and environmental influences in shaping early math proficiency.

Theoretical Underpinnings

The theoretical framework guiding early childhood mathematical thinking and learning includes developmental, learning, and mathematics education theories. These frameworks are crucial for synthesizing qualitative research on early childhood mathematical development's cognitive, social, and pedagogical aspects.

Sociocultural theory, particularly Vygotsky's (Vygotsky & Cole, 1978), emphasizes the role of social interaction, cultural tools, and the zone of proximal development in children's learning. This synthesis will examine how social interactions, language, and cultural tools influence children's mathematical thinking and understanding (Edwards, 2003).

Constructivist approaches, emphasizing learners' active role in constructing understanding, will also be integrated. This perspective informs how children engage with mathematical concepts through exploration, play, and problem-solving, aligning with their developmental characteristics (Ririn et al., 2019).

Additionally, the synthesis will draw on developmental theories such as Piaget's cognitive development theory (Inhelder & Piaget, 1958; Piaget, 1952; Piaget, 1970), which provides insights into children's cognitive stages and their construction of mathematical knowledge. Understanding the developmental progression of mathematical thinking in early childhood will offer nuanced insights into age-appropriate pedagogical strategies and the emergence of mathematical concepts (Van de Rijt et al., 2003).

By integrating sociocultural, constructivist, and developmental perspectives, this theoretical approach provides a comprehensive understanding of the factors shaping children's mathematical development. This holistic framework will inform effective pedagogical strategies and educational practices in early childhood mathematics education.

Research Questions

This qualitative synthesis explores early childhood mathematical concepts to identify effective teaching methodologies. It analyzes studies on how children best learn math, focusing on school and home environments. In essence, this paper tries to answer the following research questions:

- What teaching strategies significantly impact early mathematical skill acquisition in young children?
- How do different home environments influence early math skills, considering factors such as parental involvement, socioeconomic status, and exposure to mathematical language?
- In what ways do cognitive, linguistic, and non-symbolic skills interact and contribute to the development of early mathematical skills in children?
- How does math anxiety affect children's engagement and performance in math-related activities, and what interventions alleviate this anxiety?
-

Methodology

Research Design

This study uses a qualitative thematic synthesis to analyze and consolidate early childhood mathematical learning research. This approach comprehensively explains the cognitive processes and the interplay between mathematical aptitude and creative thinking. Thematic synthesis helps identify, categorize, and integrate themes across qualitative studies, offering a detailed map of current research and highlighting gaps for further exploration.

Data Collection

A systematic literature search was conducted across ERIC, PsycINFO, Google Scholar, Scopus, Web of Science, and TR-Dizin databases, targeting studies from 2013 to 2024. Keywords included "early childhood mathematics," "mathematical thinking," "cognitive development," "playful learning," "creativity in math," "math anxiety," and "early math education." Boolean operators were used to refine search results for comprehensive coverage.

Inclusion and Exclusion Criteria

The studies included in this synthesis focused on mathematical thinking and learning in early childhood (ages 3-8), were published in English or Turkish in peer-reviewed journals from 2013 to 2024, and addressed cognitive processes, creative thinking, and playful learning strategies. The studies excluded were those on older children or adults; non-English or non-Turkish articles; and those focusing on subjects other than mathematics.

Data Extraction

Data was extracted using a standardized form, capturing information such as study title, authors, publication year, research aims, theoretical framework, methodology, sample characteristics, main findings, and identified themes.

Data Analysis

Thematic synthesis followed Thomas and Harden's (2008) three-step process, with additional measures to ensure coding consistency and reliability.

- *Coding of Text:* The researcher read the data line by line, identifying significant phrases and concepts and assigning succinct labels. A rigorous process of reflexive journaling was employed to enhance reliability, where notes were made on coding decisions, interpretations, and any uncertainties that arose during the process. This reflexive approach allowed the researcher to track and systematically address potential biases.
- *Development of Descriptive Themes:* After establishing initial codes, the researcher grouped them into broader descriptive themes that captured various aspects of early childhood mathematical learning. To ensure consistency, the researcher revisited the themes multiple times, comparing them against the original data to verify that they accurately represented the data's nuances and patterns.
- *Generation of Analytical Themes:* Higher-order analytical themes were developed to provide deeper insights into the processes influencing early childhood mathematical thinking and learning. The researcher used peer debriefing by consulting with a colleague in the field who reviewed the analytical themes for coherence and relevance to the study's objectives. This peer consultation offered an additional layer of reliability by ensuring that the final themes were well-grounded and logically derived from the data.

These steps enhanced the consistency and reliability of the thematic synthesis process, ensuring a thorough and systematic approach to data analysis.

Critical Appraisal for Quality Assessment

The quality of included studies was assessed using the Critical Appraisal Skills Programme (2023) checklist for qualitative research. Criteria included clear research aims, appropriate methodology, research design, recruitment strategy, data collection methods, reflexivity, ethical considerations, data analysis rigor, and clarity of findings. Studies scoring poorly were discussed among peer researchers to decide on their inclusion based on their potential contribution.

Researcher Reflexivity

The researcher maintained a reflexive stance, acknowledging potential biases. Reflexive journals documented thoughts and decisions during the research process, with regular

team meetings to critically evaluate emerging themes and ensure the synthesis remained data grounded.

Ethical Considerations

Formal ethical approval was not required as the study analyzed the existing research literature. However, ethical principles were adhered to, with proper attribution given to all original studies included in the synthesis, ensuring the integrity and transparency of the research process.

Findings

The qualitative thematic analysis and synthesis of the research literature yielded the main themes, sub-themes, and codes depicted in Figure 1. Also, Table 1, the summary table, portrays the big picture of findings across multiple early childhood math education themes. The summary table presents significant focus areas and offers research synthesis from diverse sources. Overall, this analysis presents a multi-layered understanding of early childhood math education, highlighting the interplay between cognitive development, curriculum strategies, technological integration, global trends, and challenges/opportunities in the field.

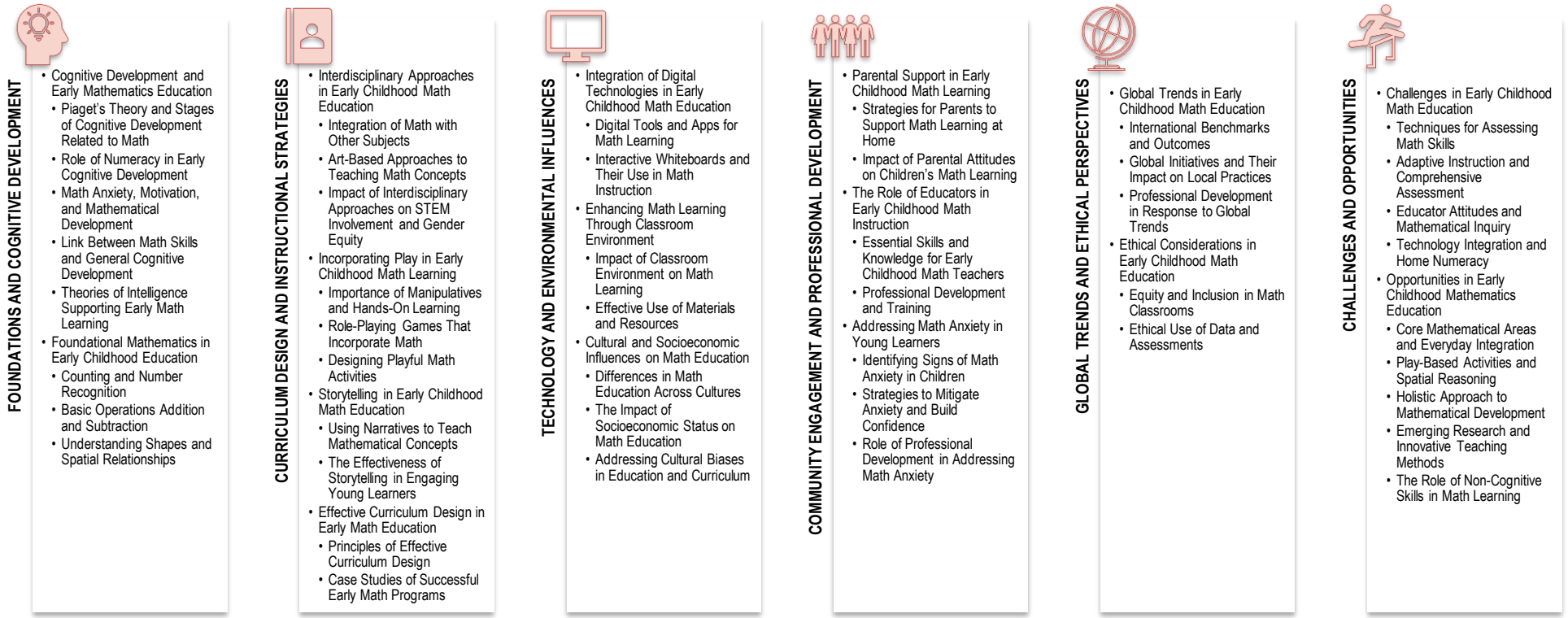


Figure 1.

The main themes, sub-themes, and codes yielded by the qualitative analysis.

Table 1.

The summary table, which depicts the main themes, sub-themes, and codes emerging from the qualitative analysis, along with the references associated with each code.

Main Theme	Sub-Theme	Code	The Number of References	Actual References
Foundations and Cognitive Development	Cognitive Development and Early Mathematics Education	Piaget's Theory and Stages of Cognitive Development Related to Math	4	Van de Rijt et al. (2003); Piaget (1952); Piaget (1970); Inhelder and Piaget (1958)
		Role of Numeracy in Early Cognitive Development	2	Segers et al. (2015); Khasanah and Purnamasari (2023)
		Math Anxiety, Motivation, and Mathematical Development	2	Wang et al. (2015); Betz (2004)
		Link Between Math Skills and General Cognitive Development	3	Gunderson et al. (2012, 2017); Cowan et al. (2011); Decker and Roberts (2015)
		Theories of Intelligence Supporting Early Math Learning	3	Bressan (2018); Aragón et al. (2016); Villeneuve et al. (2019)
	Foundational Mathematics in Early Childhood Education	Counting and Number Recognition	2	Bahnmueller et al. (2021); Kreilinger et al. (2021)
		Essential Operations Addition and Subtraction	1	Susanti (2021)
		Understanding Shapes and Spatial Relationships	1	Bahnmueller et al. (2021)
Curriculum Design and	Interdisciplinary Approaches in Early	Integration of Math with Other Subjects	3	English (2016); Schaeffer et al. (2018); Cary et al. (2021)
		Art-Based Approaches to Teaching Math Concepts	1	Fisher et al. (2012)

Instructional Strategies	Childhood Math Education	Impact of Interdisciplinary Approaches on STEM Involvement and Gender Equity	2	Dika and D'Amico (2016); Anaya et al. (2017)
	Incorporating Play in Early Childhood Math Learning	Importance of Manipulatives and Hands-On Learning	1	Istiono (2021)
		Role-Playing Games That Incorporate Math	1	Öngören and Gündoğdu (2021)
		Designing Playful Math Activities	1	Siklander et al. (2022); Barman and Kjällander (2022)
	Storytelling in Early Childhood Math Education	Using Narratives to Teach Mathematical Concepts	1	Wahyuni and Rakimahwati (2022)
		The Effectiveness of Storytelling in Engaging Young Learners	1	Cohrssen et al. (2016)
	Effective Curriculum Design in Early Math Education	Principles of Effective Curriculum Design	3	Duncan et al. (2007); Bailey et al. (2017); Lange et al. (2022)
		Case Studies of Successful Early Math Programs	2	Pitchford et al. (2016); Supekar et al. (2015)
Technology and Environmental Influences	Integration of Digital Technologies in Early Childhood Math Education	Digital Tools and Apps for Math Learning	3	Outhwaite et al. (2023); Chen (2019); Ahmad and Junaini (2020)
		Interactive Whiteboards and Their Use in Math Instruction	2	Outhwaite et al. (2019); Moyer-Packenham (2019)
	Enhancing Math Learning Through Classroom Environment	Impact of Classroom Environment on Math Learning	2	Eccles and Roeser (2011); O'Hara et al. (2022)
		Effective Use of Materials and Resources	2	Van Dijk et al. (2019); Blazar (2015)
		Differences in Math Education Across Cultures	1	Marsh and Hau (2004)

	Cultural and Socioeconomic Influences on Math Education	The Impact of Socioeconomic Status on Math Education	1	Olsen and Huang (2021)
		Addressing Cultural Biases in Education and Curriculum	1	Turner et al. (2024)
Community Engagement and Professional Development	Parental Support in Early Childhood Math Learning	Strategies for Parents to Support Math Learning at Home	2	Pan et al. (2023); Schaeffer et al. (2018)
		Impact of Parental Attitudes on Children's Math Learning	5	Maloney et al. (2015); Hildebrand et al. (2023); Silver et al. (2023); Gürgah Oğul and Aktaş Arnas (2022); Leyva et al. (2021)
	The Role of Educators in Early Childhood Math Instruction	Essential Skills and Knowledge for Early Childhood Math Teachers	1	Depaepe et al. (2020)
		Professional Development and Training	4	Gaumer Erickson et al. (2017); Mulcahy et al. (2021); Wood and Hedges (2016); Demir (2022)
	Addressing Math Anxiety in Young Learners	Identifying Signs of Math Anxiety in Children	1	Ramirez et al. (2016)
		Strategies to Mitigate Anxiety and Build Confidence	2	Wu et al. (2012); Cargnelutti et al. (2017)
		Role of Professional Development in Addressing Math Anxiety	2	Maloney et al. (2015); Van Mier et al. (2018)
Global Trends and Ethical Perspectives	Global Trends in Early Childhood Math Education	International Benchmarks and Outcomes	2	Moss et al. (2016); Moss and Urban (2019)
		Global Initiatives and Their Impact on Local Practices	2	Mueller and File (2015); Gibbs et al. (2017)
		Professional Development in Response to Global Trends	1	Piasta et al. (2015)

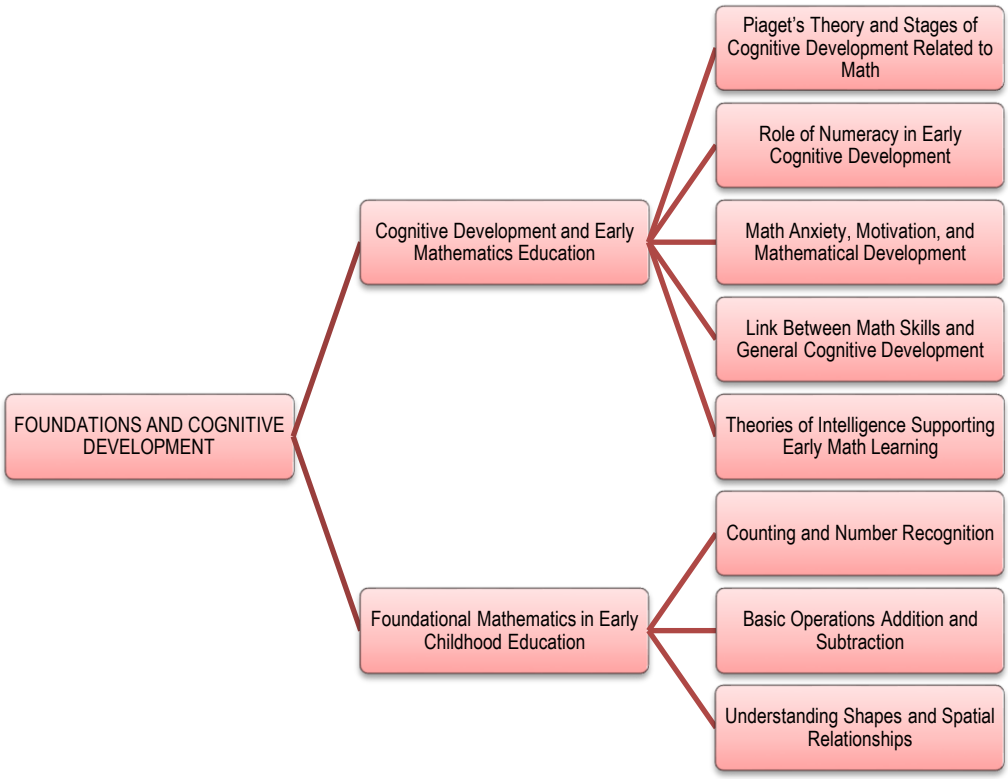
	Ethical Considerations in Early Childhood Math Education	Equity and Inclusion in Math Classrooms	2	Priniski and Thoman (2020); Yu (2022)
		Ethical Use of Data and Assessments	2	Briggle et al. (2016); Angermund and Plant (2017)
Challenges and Opportunities	Challenges in Early Childhood Math Education	Techniques for Assessing Math Skills	2	Jordan et al. (2009); Fuchs et al. (2005)
		Adaptive Instruction and Comprehensive Assessment	3	O'Malley et al. (2014); Elliott and Bachman (2018); Dunphy (2009)
		Educator Attitudes and Mathematical Inquiry	2	Johnston and Bull (2022); Schillinger (2021)
		Technology Integration and Home Numeracy	2	Utama et al. (2022); Zaranis et al. (2013)
	Opportunities in Early Childhood Mathematics Education	Core Mathematical Areas and Everyday Integration	2	Dyson et al. (2013); Lee (2014)
		Play-Based Activities and Spatial Reasoning	2	Cohrssen et al. (2016); Cohrssen et al. (2017)
		Holistic Approach to Mathematical Development	3	Elia et al. (2021); Hedge and Cohrssen (2019); Yair and Chis (2022)
		Emerging Research and Innovative Teaching Methods	3	Duncan et al. (2007); Libertus (2024); Pan et al. (2023)
		The Role of Non-Cognitive Skills in Math Learning	2	Björklund et al. (2020); Lange et al. (2022)

Results

Theme 1: Foundations and Cognitive Development

This theme elaborates the sub-themes and codes given in Figure 2 in 18 references.

Figure 2. Thematic representation of "Foundations and Cognitive Development"



Cognitive Development and Early Mathematics Education

Jean Piaget's theory of cognitive development provides a framework for understanding children's mathematical thinking through the sensorimotor, preoperational, concrete operational, and formal operational stages of development. Each stage introduces cognitive abilities essential for developing math skills. Numeracy is crucial in early cognitive development, with cognitive and linguistic abilities and a supportive home numeracy environment significantly contributing to numeracy skills.

- ***Piaget's Theory and Stages of Cognitive Development Related to Math:*** Piaget's theory explains the evolution of children's mathematical thinking (Inhelder & Piaget, 1958; Piaget, 1952; Piaget, 1970). Children grasp symbols and words during the preoperational stage, while the concrete operational stage introduces abilities like conservation and classification essential for mathematical reasoning (Inhelder & Piaget, 1958; Piaget, 1952; Piaget, 1970; Van de Rijt et al., 2003).

- ***Role of Numeracy in Early Cognitive Development:*** Numeracy forms the foundation of children's academic and practical skills. Cognitive and linguistic abilities predict numeracy skills, nurtured by a home environment where parents actively engage in numeracy-related activities. Interactive activities like role-playing enhance counting and numeracy literacy (Segers et al., 2015; Khasanah & Purnamasari, 2023).
- ***Math Anxiety, Motivation, and Mathematical*** Development*:* Math anxiety and motivation significantly affect math skills development. Math anxiety deters engagement, while high motivation and self-efficacy promote positive attitudes toward learning math (Betz, 2004; Wang et al., 2015). Longitudinal studies are recommended to understand these factors' long-term impact (Wang et al., 2015).
- ***Link Between Math Skills and General Cognitive*** Development*:* Math and cognitive development are closely linked. Working memory and inhibitory control are tied to math problem-solving (Decker & Roberts, 2015). Improvements in basic calculations are predicted by conceptual knowledge and cognitive development (Cowan et al., 2011). A growth mindset enhances responses to academic challenges and improves math achievement (Gunderson et al., 2012; Gunderson et al., 2017).
- ***Theories of Intelligence Supporting Early Math Learning:*** Theories of intelligence provide insights into cognitive styles affecting math abilities. Systemizing, a cognitive style focused on analyzing systems, is linked to mathematical intelligence (Bressan, 2018). Structural equation models show the complex relationship between cognitive and non-cognitive factors in developing math skills (Aragón et al., 2016). An integrated approach is needed to understand and foster mathematical thinking (Villeneuve et al., 2019).

Foundational Mathematics in Early Childhood Education

In early childhood education, foundational math skills like counting, number recognition, and basic operations are crucial for later mathematical abilities. Developing these skills through tactile and visual methods, such as using fingers for counting, helps children form mental representations of numbers. Cultural and contextual aspects of learning basic arithmetic, like addition and subtraction, highlight the importance of integrating cultural perspectives to enhance comprehension and application.

- ***Counting and Number Recognition:*** Counting and number recognition are critical foundational skills in early childhood education. Using tactile and visual cues, such as fingers for counting, is vital in forming mental representations of numbers. Children associate specific finger patterns with numerical quantities, helping develop number sense (Bahnmueller et al., 2021). This tactile involvement supports counting skills and enhances the ability to recognize numbers through structured patterns, such as those seen on dice or fingers, further linking physical representations to mental arithmetic skills (Kreilinger et al., 2021).
- ***Basic Operations: Addition and Subtraction:*** Developing basic arithmetic operations, like addition and subtraction, is essential in early mathematical

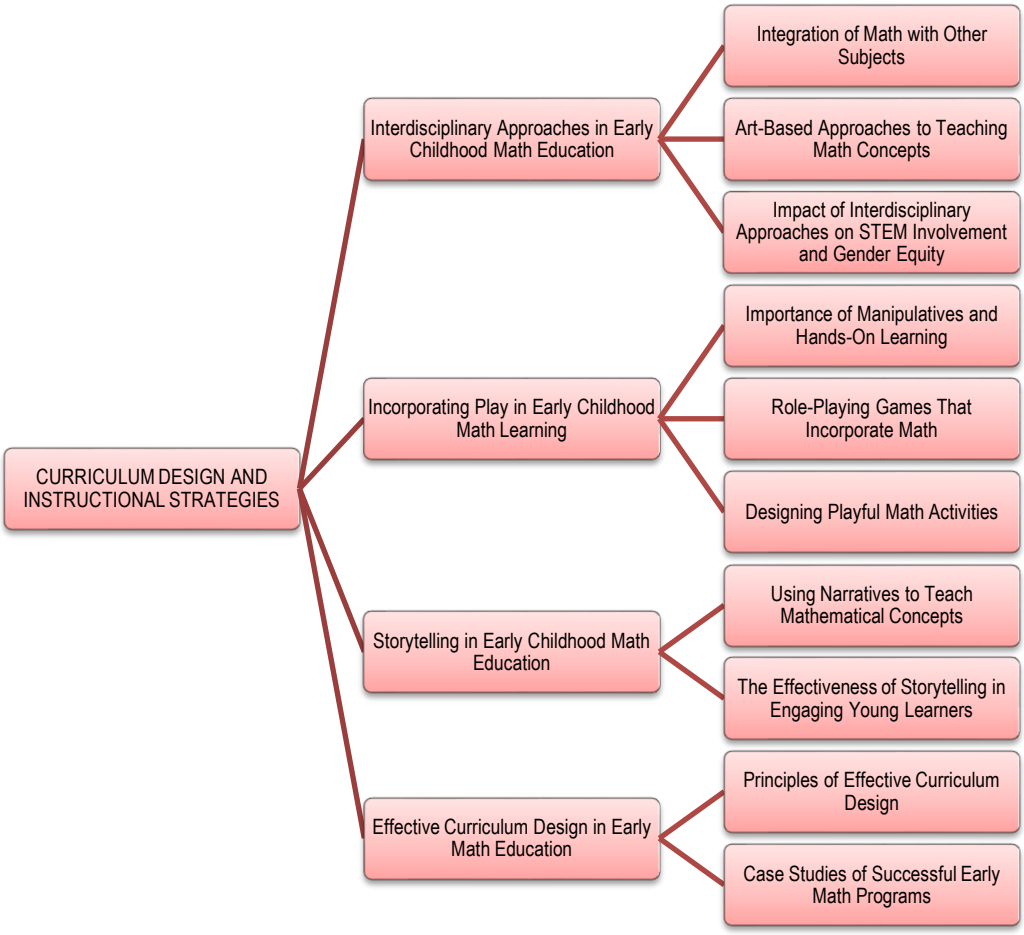
education. Research in ethnomathematics reveals that cultural and contextual factors significantly influence how these operations are understood and applied, suggesting that mathematical concepts are cognitively and culturally embedded (Susanti, 2021). This highlights the importance of considering cultural context in teaching arithmetic, shaping how children understand and perform mathematical operations.

- ***Understanding Shapes and Spatial Relationships:*** Understanding shapes and spatial relationships is crucial for mathematical development in young children. Recognizing and making sense of various shapes and their spatial relationships is critical for developing geometric thinking. Engaging children in tactile and visual interactions with shapes enhances spatial awareness and the ability to understand complex spatial relationships (Bahnmueller et al., 2021).

Theme 2: Curriculum Design and Instructional Strategies

This theme elaborates the sub-themes and codes given in Figure 3 in 16 references.

Figure 3. Thematic representation of "Curriculum Design and Instructional Strategies"



Interdisciplinary Approaches in Early Childhood Math Education

Interdisciplinary approaches in early childhood math education enhance learning outcomes and address challenges. Integrating math with other disciplines, such as art and science, makes learning more inclusive and engaging, reducing math anxiety among students and parents. This approach enriches the educational experience, closes knowledge gaps, and fosters appreciation for math in different contexts.

- ***Integration of Math with Other Subjects:*** Integrating math with other subjects enhances educational outcomes and addresses learning challenges. Schaeffer et al. (2018) show that using math applications reduces parental math anxiety, improving attitudes toward math. Cary et al. (2021) highlight the need for targeted strategies to address initial math knowledge gaps. Integrating math with STEM fields promotes a holistic understanding and relevance of math concepts in scientific and technological contexts (English, 2016).
- ***Art-Based Approaches to Teaching Math Concepts:*** Art-based approaches use creative expression to teach math, making abstract concepts more tangible (Fisher et al., 2012). This method involves painting, drawing, or sculpting, enhancing children's understanding and engagement with math. Integrating art into math education increases children's interest and enthusiasm.
- ***Impact of Interdisciplinary Approaches on STEM Involvement and Gender Equity:*** Interdisciplinary approaches significantly impact students' interest and persistence in STEM fields. These methods enhance engagement and persistence, developing math skills and positive attitudes (Dika & D'Amico, 2016). They also address gender gaps in STEM, promoting equity and inclusion (Anaya et al., 2017).

Incorporating Play into Early Childhood Math Learning

Integrating play into early childhood math learning engages young learners and enhances their understanding of mathematical concepts. Using manipulatives and hands-on tools makes abstract ideas tangible, helping children grasp complex principles. Integrating math into role-playing games and designing playful activities provides dynamic, context-rich learning experiences that stimulate interest and foster more profound understanding.

- ***Importance of Manipulatives and Hands-on Learning:*** Manipulatives are crucial in early childhood math education. They make abstract concepts more concrete, aiding children's transition from concrete to abstract thinking (Istiono, 2021). These tools help children visualize and physically manipulate mathematical elements, enhancing understanding and retention.
- ***Role-Playing Games Incorporating Math:*** Role-playing games that integrate math offer dynamic and contextualized learning. These games encourage children to apply math in practical scenarios, leading to a deeper understanding of mathematical principles (Öngören & Gündoğdu, 2021). Role-playing games

make math relevant and exciting by simulating real-life situations and fostering engagement through interactive play.

- *Designing Playful Math Activities:* Creating playful activities fosters an engaging learning environment. These activities develop positive attitudes toward math and increase motivation by making math fun and accessible (Barman & Kjällander, 2022; Siklander et al., 2022). Playful learning integrates the joy of play with education, allowing children to explore mathematical concepts in a relaxed, supportive setting. This approach promotes cognitive, social, and emotional development.

Storytelling in Early Childhood Math Education

Storytelling is a powerful tool in early childhood math education. It engages young learners and contextualizes mathematical concepts. Narratives transform abstract ideas into relatable content, helping children understand complex concepts through familiar stories.

- *Using Narratives to Teach Mathematical Concepts:* Narratives effectively teach early childhood math by contextualizing and demystifying abstract ideas (Wahyuni & Rakimahwati, 2022). Storytelling frames mathematical problems in engaging contexts, making complex ideas more understandable for young children.
- *Effectiveness of Storytelling in Engaging Young Learners:* Storytelling captures children's attention and stimulates their imagination, creating a dynamic learning environment (Cohrssen & Page, 2016). Integrating storytelling with play-based activities has transformed educators' teaching approaches, making math educational and engaging (Cohrssen et al., 2016).

Effective Curriculum Design in Early Math Education

Effective curriculum design in early math education focuses on creating a framework supporting critical mathematical thinking development. Research shows that early math skills significantly predict future academic success, highlighting their importance in educational planning. An effective curriculum integrates a constructivist approach, promoting active learning through interaction and exploration and aligning with national educational standards.

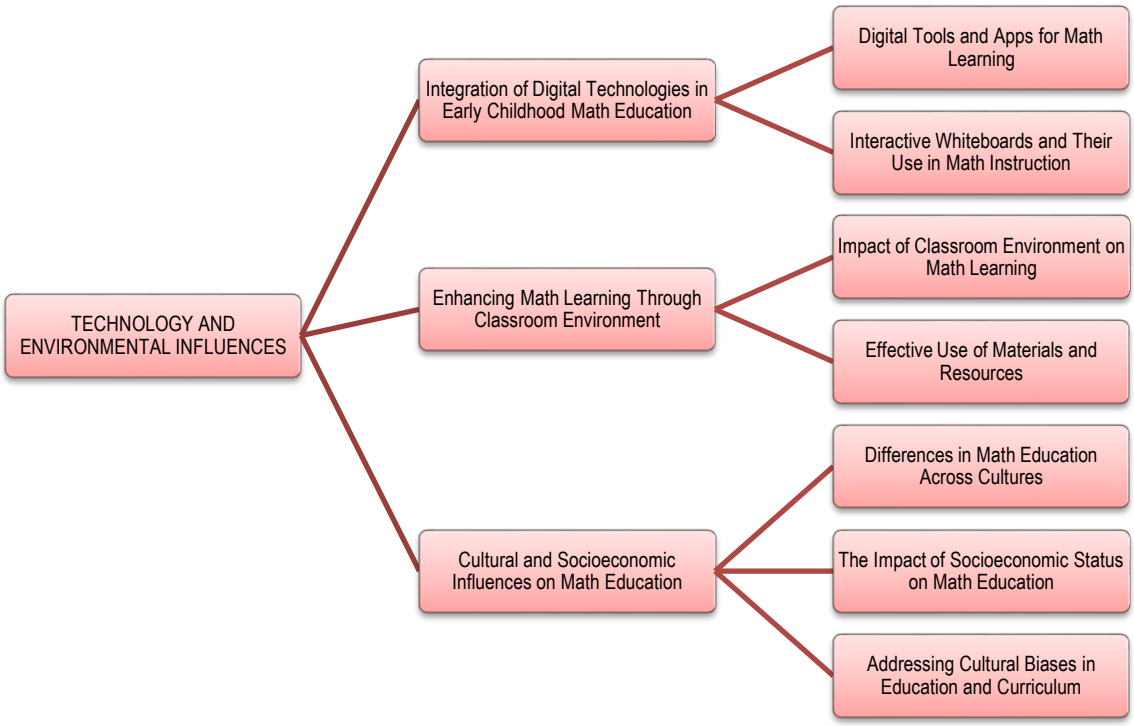
- *Principles of Effective Curriculum Design:* Effective early math curriculum design fosters comprehensive mathematical thinking. Early math skills are critical predictors of later academic achievement, making them central to curriculum planning (Duncan et al., 2007). Quality learning environments that sustain gains post-intervention are crucial for maintaining early skill development (Bailey et al., 2017). A constructivist approach, advocating for active learning, aligns with national standards for math and science education (Lange et al., 2022).
- *Case Studies of Successful Early Math Programs:* Successful programs integrate various skills into the curriculum. For instance, fine motor skills correlate with math

ability, emphasizing the need for a curriculum that promotes a broad skill set (Pitchford et al., 2016). Remedial programs addressing math anxiety, such as cognitive tutoring, reduce anxiety and neurological reactivity related to fear and stress, improving learning outcomes (Supekar et al., 2015).

Theme 3: Technology and Environmental Influences

This theme elaborates the sub-themes and codes given in Figure 4 in 12 references.

Figure 4. Thematic representation of "Technology and Environmental Influences"



Integration of Digital Technologies in Early Childhood Math Education

Digital technologies are essential in early childhood math education, providing interactive tools and apps that cater to diverse learning styles. Educational math apps and augmented reality offer personalized content that enhances learning outcomes, increases motivation, and reduces math anxiety. Interactive whiteboards and digital math games offer dynamic, visual learning platforms that foster hands-on exploration of mathematical concepts and practical applications.

- *Digital Tools and Apps for Math Learning:* Digital tools and apps are adequate early childhood math education resources. These technologies provide interactive learning experiences for various learning styles. Educational math apps enhance learning outcomes by offering personalized content (Outhwaite et al., 2023). Mobile augmented reality improves performance, increases motivation, and

reduces math anxiety, showing its value in math education (Ahmad & Junaini, 2020; Chen, 2019).

- *Interactive Whiteboards in Math Instruction:* Interactive whiteboards facilitate math instruction by offering a dynamic and visual learning platform. They enhance student engagement and participation (Outhwaite et al., 2019). Digital math games with interactive whiteboards help children understand practical math applications, improving learning outcomes (Moyer-Packenham, 2019).

Enhancing math learning through the classroom environment

The classroom environment significantly shapes young children's math learning experiences. A favorable climate and effective use of materials impact students' emotions, motivation, and learning outcomes, helping to reduce math anxiety. Creating a supportive atmosphere increases children's engagement and success in mathematics.

- *Impact of Classroom Environment on Math Learning:* A positive classroom environment shapes children's math learning. Supportive and engaging atmospheres influence students' emotions, motivation, and outcomes (Eccles & Roeser, 2011; O'Hara et al., 2022). Such environments reduce math anxiety, enhancing engagement and success in math.
- *Effective Use of Materials and Resources:* Effectively using materials and resources promotes mathematical thinking in early childhood. Hands-on and interactive materials are essential for developing foundational math skills (Blazar, 2015; Van Dijk et al., 2019). The quality and integration of these resources determine student engagement and understanding. Selecting resources that align with educational goals and cater to diverse needs is critical.

Cultural and Socioeconomic Influences on Math Education

Math education varies across cultures and is shaped by cultural norms that influence teaching methods, curriculum design, and student attitudes. Understanding these cultural elements is essential to effectively addressing the needs of diverse student populations. Socioeconomic status also plays a significant role, impacting access to quality resources and contributing to disparities in math achievement.

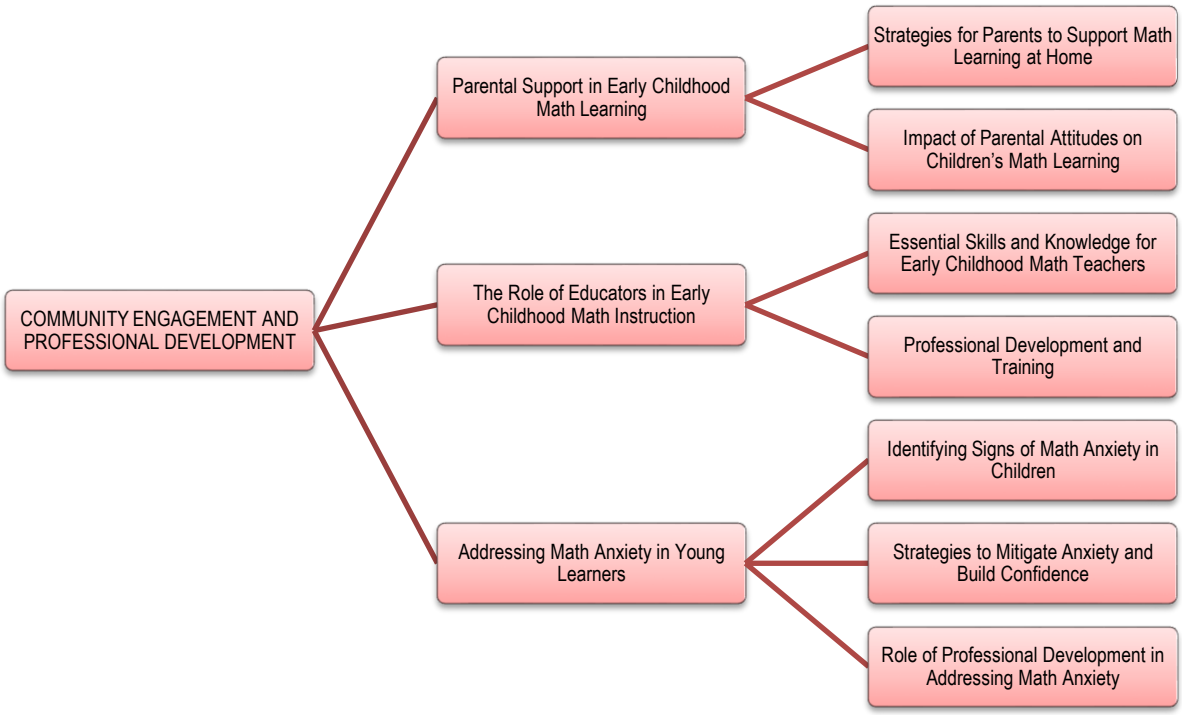
- *Differences in Math Education Across Cultures:* Math education is influenced by cultural norms and values, affecting teaching methods, curriculum design, and student attitudes (Marsh & Hau, 2004). These differences result in diverse educational practices and experiences, highlighting the need to integrate cultural elements into teaching to serve diverse students better.
- *Impact of Socioeconomic Status on Math Education:* Socioeconomic status affects access to quality math education, with students from lower socioeconomic backgrounds facing barriers to resources and opportunities. This leads to significant differences in math achievement, underscoring the need for interventions to address these inequalities (Olsen & Huang, 2021). Equitable access to resources is essential for mitigating these disparities.

- ***Addressing Cultural Biases in Education and Curriculum:*** Cultural biases in education disadvantage certain student groups by influencing content and teaching methods. Addressing these biases is crucial for inclusive and equitable math education (Turner et al., 2024). Culturally responsive teaching recognizes and values students' cultural backgrounds, integrating these perspectives into the curriculum to create a respectful learning environment.

Theme 4: Community Engagement and Professional Development

This theme elaborates the sub-themes and codes given in Figure 5 in 17 references.

Figure 5. Thematic representation of "Community Engagement and Professional Development"



Parental Support in Early Childhood Math Learning

Parental support is crucial for developing early math skills. Engaging children in number games and math talks at home enhances their numerical understanding. Integrating math into everyday activities encourages skill development in a relaxed setting. Parents' active involvement in educational interventions also improves children's math outcomes.

- ***Strategies for Parents to Support Math Learning at Home:*** Parental involvement nurtures early math skills. Engaging children in math activities, like number games and math talks, directly impacts their abilities (Pan et al., 2023). Integrating math into daily activities in a relaxed environment enhances numerical skills. Active parental participation in educational interventions significantly improves math learning outcomes (Schaeffer et al., 2018).

- ***Impact of Parental Attitudes on Children's Math Learning:*** Parental attitudes toward math significantly influence children's learning. Negative attitudes and math anxiety in parents lead to similar feelings in children, affecting their performance and engagement (Hildebrand et al., 2023; Maloney et al., 2015). Positive attitudes are linked to reduced anxiety and increased engagement in math activities (Silver et al., 2023). The home educational environment, including socioeconomic status and parental involvement, also shapes children's math development (Gürgah Oğul & Aktaş Arnas, 2022; Leyva et al., 2021).

The Role of Educators in Early Childhood Math Instruction

Educators need solid skills and knowledge to foster young children's mathematical understanding. A profound grasp of foundational math concepts and strategies for encouraging mathematical thinking is essential. Additionally, teachers must create an inclusive environment encouraging engagement and supporting students' interest in math.

- ***Essential Skills and Knowledge for Early Childhood Math Teachers:*** Teachers need robust skills and knowledge to foster mathematical thinking. This includes a deep understanding of early math concepts and effective pedagogical strategies (Depaepe et al., 2020). Creating a supportive and inclusive learning environment is crucial for engaging children and cultivating their interest in math from an early age.
- ***Professional Development and Training:*** Professional development is critical for enhancing teachers' skills and knowledge in early childhood math. Ongoing training improves instructional practices and content knowledge (Gaumer Erickson et al., 2017; Mulcahy et al., 2021). Programs should also address culturally responsive teaching, socioeconomic impacts, and cultural biases in the curriculum (Demir, 2022; Wood & Hedges, 2016).

Addressing Math Anxiety in Young Learners

Identifying and addressing math anxiety in young learners is crucial for their mathematical development. Signs of anxiety, such as avoidance, negative attitudes, and emotional distress during math activities, hinder learning. Recognizing these signs helps parents and educators tailor support strategies to promote confidence and foster a positive attitude toward mathematics.

- ***Identifying Signs of Math Anxiety in Children:*** Early signs of math anxiety, such as avoiding math activities, negative attitudes, and emotional distress, are crucial for timely intervention (Ramirez et al., 2016). Recognizing these signs allows educators and parents to provide the necessary support.
- ***Strategies to Mitigate Anxiety and Build Confidence:*** Several strategies mitigate math anxiety and build confidence. Creating a supportive and inclusive learning environment with hands-on and interactive math experiences is fundamental (Wu et al., 2012). Promoting a growth mindset, developing a positive math self-

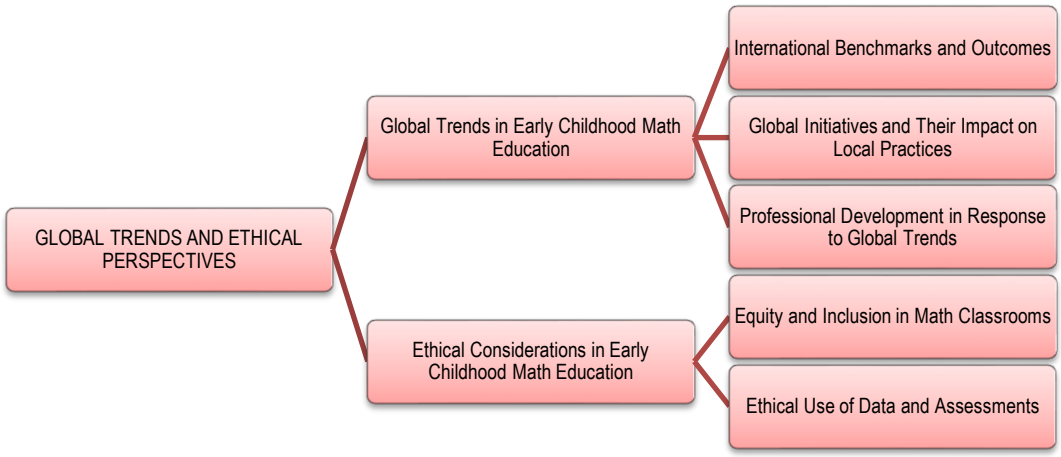
concept, and providing targeted support for struggling learners are practical approaches (Cargnelutti et al., 2017).

- ***Role of Professional Development in Addressing Math Anxiety:*** Professional development for educators is essential in addressing math anxiety. Training programs should focus on creating positive math learning environments, implementing evidence-based strategies, and encouraging a growth mindset (Maloney et al., 2015). Collaboration among educators, parents, and mental health professionals enhances the support system, providing a holistic approach to tackling math anxiety (Van Mier et al., 2018).

Theme 5: Global Trends and Ethical Perspectives

This theme elaborates the sub-themes and codes given in Figure 6 in 9 references.

Figure 6. Thematic representation of "Global Trends and Ethical Perspectives"



Global Trends in Early Childhood Math Education

Global trends in early childhood math education influence local policies and teaching practices. International assessments like the IELS provide data-driven insights but raise concerns about over-standardization, highlighting the need for culturally relevant practices.

- ***International Benchmarks and Outcomes:*** The Organisation for Economic Co-operation and Development (OECD) establishes international benchmarks for early childhood education through initiatives like the International Early Learning and Child Well-being Study (IELS) (Moss et al., 2016). These benchmarks influence local policies by providing data-driven insights. However, concerns about reducing education to a technical exercise and the risk of global standardization exist (Moss & Urban, 2019).
- ***Global Initiatives and Their Impact on Local Practices:*** Global initiatives by organizations like the OECD significantly impact local educational practices. These initiatives lead to revising policies and curricula to improve early learning

outcomes. They also prompt reevaluation of teacher preparation programs to align with contemporary standards (Mueller & File, 2015). Cultural and societal factors also influence these trends, as seen in the Asian American Advantage in Math (Gibbs et al., 2017).

- ***Professional Development in Response to Global Trends:*** Professional development is essential for educators to adapt to global trends in math education. Effective programs enhance pedagogical content knowledge and instructional quality (Piasta et al., 2012; Piasta et al., 2015). They equip educators to meet international benchmarks and address diverse learner needs.

Ethical Considerations in Early Childhood Math Education

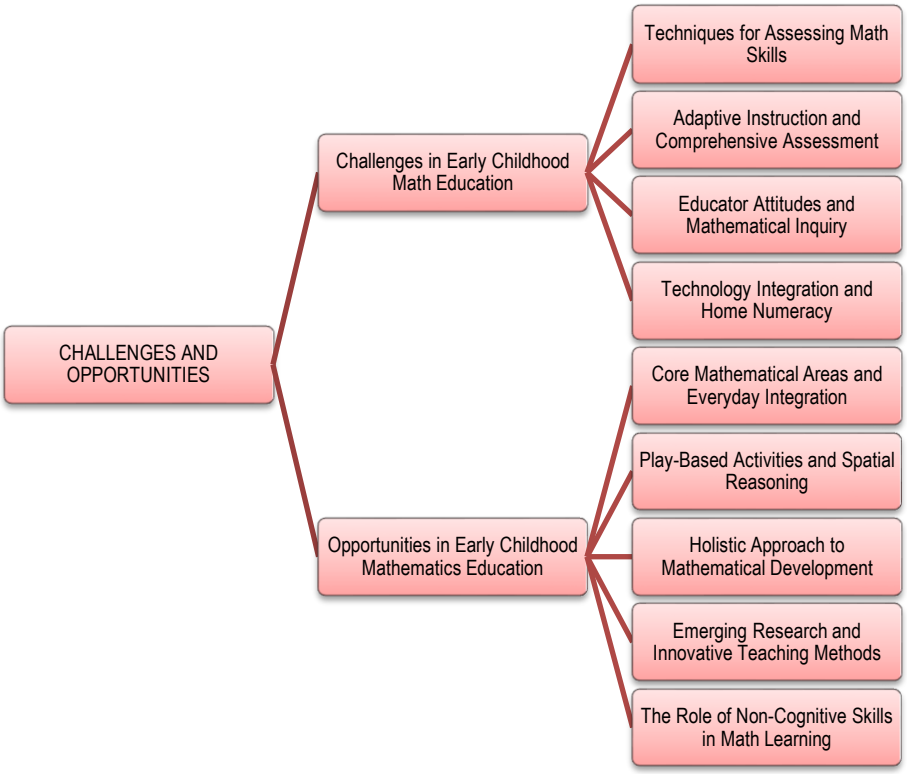
Ethical considerations in early childhood math education focus on fostering equity, inclusion, and responsible use of assessment data. Creating a respectful classroom environment that acknowledges diverse cultural perspectives and systemic biases ensures equitable access to meaningful math learning. Fair and transparent assessments further contribute to this goal by informing instructional practices and helping bridge educational gaps.

- ***Equity and Inclusion in Math Classrooms:*** Equity and inclusion are essential for creating a respectful learning environment that accommodates diverse cultural perspectives and addresses systemic biases. Educators promote these values by integrating social justice and utility-value approaches to teaching, which help bridge gaps in educational equity (Priniski & Thoman, 2020). Combatting stereotypes and using culturally inclusive pedagogies significantly enhance student achievement and ensure an equitable learning environment for all students (Yu, 2022).
- ***Ethical Use of Data and Assessments:*** Ethical use of data and assessments ensures fair and unbiased evaluations of students' mathematical abilities. Key considerations include protecting student privacy, maintaining valid and reliable assessment tools, and using assessment data to guide equitable instructional practices (Briggle et al., 2016). It is crucial to evaluate how assessment practices affect students' learning experiences and outcomes, focusing on fairness and transparency. These practices help build an ethical organizational culture and promote ethical decision-making among educators (Angermund & Plant, 2017).

Theme 6: Challenges and Opportunities

This theme elaborates the sub-themes and codes given in Figure 7 in 21 references.

Figure 7. Thematic representation of "Challenges and Opportunities"



Challenges in Early Childhood Math Education

Early childhood math education challenges include assessing math skills, adapting instructional strategies, and integrating technology. Early math competence predicts future academic success, emphasizing the need for comprehensive assessment techniques to identify difficulty predictors and cognitive determinants. Additionally, understanding the home numeracy environment helps meet diverse learning needs.

- ***Techniques for Assessing Math Skills:*** Assessing math skills in early childhood is crucial for identifying strengths and areas for improvement. Early math competence predicts later academic success (Jordan et al., 2009). Predictors of math difficulties include nonverbal problem-solving, working memory, and phonological processing (Fuchs et al., 2005). Comprehensive evaluations of cognitive determinants are necessary to understand math difficulties fully.
- ***Adaptive Instruction and Comprehensive Assessment:*** Adapting instructional methods to diverse student needs is challenging. Incorporating technology, such as iPads, enhances academic task completion, particularly for students with special needs (O'Malley et al., 2014). Understanding and improving the home numeracy environment supports math skill development (Elliott & Bachman, 2018). Adaptive instruction and comprehensive assessments are essential for

inclusive education, ensuring a solid foundation for future math learning (Dunphy, 2009).

- *Educator Attitudes and Mathematical Inquiry:* Educators' attitudes toward math influence how they teach mathematical concepts. Developing positive dispositions and self-efficacy in teaching math is crucial (Johnston & Bull, 2022; Schillinger, 2021). Emphasizing conceptual understanding and mathematical inquiry in the curriculum is vital.
- *Technology Integration and Home Numeracy:* Technology enhances early childhood math education. Tools like iPads enrich learning and meet diverse educational needs. Understanding the home numeracy environment ensures that learning extends beyond the classroom, accommodating various backgrounds and family structures (Utama et al., 2022; Zaranis et al., 2013).

Opportunities in Early Childhood Mathematics Education

Early childhood math education opportunities involve integrating core mathematical areas and everyday activities, which help build a solid foundation. Play-based activities enhance spatial reasoning and foster positive attitudes toward math. Recent research highlights the role of cognitive and non-cognitive skills, socioeconomic factors, and home environments in math learning.

- *Core Mathematical Areas and Everyday Integration:* The National Research Council identifies number sense and geometry as core areas needing attention in preschool and kindergarten. Integrating these concepts into daily activities is crucial for establishing a solid foundation and making math relevant to children's lives (Dyson et al., 2013; Lee, 2014).
- *Play-Based Activities and Spatial Reasoning:* Play-based activities positively impact educators' attitudes toward teaching math and enhance children's spatial reasoning. Emphasizing geometry and spatial reasoning through play benefits children's understanding and application of mathematical concepts (Cohrssen et al., 2016; Cohrssen et al., 2017).
- *Holistic Approach to Mathematical Development:* A holistic approach integrates mathematical concepts into daily experiences and fosters positive attitudes. This method supports children's overall development and lays a robust foundation for future mathematical success (Elia et al., 2021; Hedge & Cohrssen, 2019; Yair & Chiş, 2022).
- *Emerging Research and Innovative Teaching Methods:* Recent research identifies effective strategies for fostering math skills. Early math competence predicts later success (Duncan et al., 2007). Home learning opportunities significantly influence math abilities (Libertus, 2024). Family socioeconomic status also shapes children's math experiences (Pan et al., 2023).
- *The Role of Non-Cognitive Skills in Math Learning:* Non-cognitive skills are crucial. Early education promotes equality and provides a solid foundation for all children (Björklund et al., 2020). Participation in STEM experiences during training

enhances non-cognitive skills like perseverance, benefiting math teaching (Lange et al., 2022).

Discussion

Foundations and Cognitive Development

Research indicates that early mathematical thinking develops through cognitive growth stages, as outlined by Jean Piaget, and is supported by home environments and parental involvement. Math anxiety and motivation significantly impact children's engagement, making emotional and motivational factors crucial for success. Studies show a connection between cognitive abilities, like working memory and problem-solving, and math proficiency, emphasizing a comprehensive educational approach. Recognizing cognitive styles can enhance math capabilities, advocating for tailored educational strategies. Tactile and visual methods in early childhood education help children form concrete mental representations of numbers. Considering cultural factors in arithmetic teaching improves comprehension. Integrating cognitive, cultural, and emotional dimensions provides an effective educational framework for early mathematical learning and future success.

Curriculum Design and Instructional Strategies

Effective curriculum design integrates interdisciplinary approaches, playful learning, and storytelling. Combining math with art and science creates a holistic educational framework, reducing math anxiety and engaging learners. Play-based activities and storytelling make abstract concepts tangible and relatable. A robust curriculum supports mathematical thinking through constructivist approaches and remedial strategies, addressing diverse learning needs. These methods create inclusive environments that foster cognitive, social, and emotional growth.

Technology and Environmental Influences

Incorporating digital technologies and shaping the classroom environment are crucial in early childhood math education. Tools like educational apps and interactive whiteboards provide personalized learning experiences that enhance understanding and engagement. A supportive classroom atmosphere influences students' motivation and emotions, while effective educational materials enable interactive exploration of math concepts, building foundational skills, and reducing math anxiety. Addressing cultural and socioeconomic factors is essential for equitable learning opportunities. A comprehensive approach to math education incorporates technology, optimizes the learning environment, and considers cultural and socioeconomic contexts.

Community Engagement and Professional Development

Parental support is fundamental in nurturing early math skills, integrating math into daily activities at home, and enhancing educational outcomes. Educators need strong

pedagogical and content knowledge, supported by professional development to refine teaching practices and address challenges like cultural biases. Recognizing and addressing math anxiety involves creating inclusive, interactive learning environments. Promoting a growth mindset and providing targeted support builds confidence in struggling learners. Collaboration among educators, parents, and mental health professionals creates a support system that nurtures resilience and confidence in math.

Global Trends and Ethical Perspectives

Global trends in early childhood math education are influenced by international benchmarks and assessments. Initiatives like the OECD's International Early Learning and Child Well-being Study provide data-driven insights, though over-standardization concerns highlight the need for culturally relevant practices. Ethical considerations involve fostering equity, inclusion, and responsible data use and creating respectful classroom environments that acknowledge diversity. Fair and transparent assessments ensure unbiased evaluations, guiding instruction and bridging educational gaps. Promoting inclusive teaching and responsible data use ensures equitable learning opportunities, allowing educators to uphold every child's dignity and potential.

Challenges and Opportunities

Challenges in early childhood math education include assessing skills, adapting instruction, and integrating technology. Early math competence predicts future success, requiring comprehensive assessment techniques. Adaptive instruction must cater to diverse learning needs, and technology integration enhances engagement. Educator attitudes significantly impact teaching; positive dispositions toward math are essential. Effective professional development boosts confidence in teaching mathematical inquiry. Opportunities involve integrating core mathematical areas into daily activities and fostering positive attitudes through play-based activities. Emerging research highlights the importance of non-cognitive skills and socioeconomic factors in shaping engagement and success. Leveraging these opportunities helps educators navigate challenges with adaptive methods, fostering inclusive environments, and building a solid foundation for future math success.

Insights for Teachers Aiming to Improve Early Mathematics Instruction

These findings offer valuable insights for teachers aiming to improve early mathematics instruction. Educators can use these insights to create engaging and supportive learning environments, fostering mathematical abilities in young children through targeted, evidence-based strategies.

Teachers might begin by emphasizing **play-based and hands-on learning activities** that build foundational skills through interactive experiences. Manipulatives, such as blocks and counters, provide a tactile approach, helping children explore concepts like counting, sorting, and basic arithmetic. Incorporating storytelling and role-playing games can

make abstract mathematical ideas more tangible and relatable, as Cohrssen et al. (2016) observed, supporting both engagement and comprehension.

The study also highlights the importance of **fostering spatial skills** through activities that encourage spatial reasoning, like puzzles and shape-based tasks, which contribute to mathematical development (Deans & Cohrssen, 2015; Cortes et al., 2022). Teachers can embed these tasks within daily routines or use them as part of guided play sessions to promote children's ability to visualize and manipulate spatial relationships, a skill foundational for more advanced mathematical thinking.

In terms of **social and emotional factors**, educators should be aware of math anxiety's role in shaping children's learning experiences. Teachers can adopt strategies that cultivate a growth mindset and confidence in math-related activities. Positive reinforcement, a supportive atmosphere, and gradual exposure to math tasks can help reduce stress and build resilience (DePascale et al., 2023; Douglas & LeFevre, 2018). Additionally, by fostering positive interactions during math-related play, teachers can instill a love for mathematics and mitigate the effects of anxiety.

Finally, technology integration offers unique ways to enhance engagement and learning. Digital tools, such as educational math apps and interactive whiteboards, can provide customized learning experiences, cater to diverse learning styles, and support students who benefit from visual or interactive content (Ahmad & Junaini, 2020; Chen, 2019). These tools also make abstract concepts more accessible and can be used in both individual and group settings to reinforce foundational skills.

Overall, findings of this study underscore the value of a holistic approach, blending cognitive, social, and technological strategies to foster early mathematical thinking. Teachers who integrate these practices are well-positioned to enhance early childhood math education and promote a lifelong positive attitude toward mathematics.

Research Gaps Identified and Suggestions for Future Research

This research endeavor on early childhood mathematical development reveals several gaps that limit our understanding. Key gaps include:

- ***Cultural Contexts:*** Most studies focus on Western contexts, overlooking the influence of diverse cultural backgrounds on mathematical understanding.
- ***Longitudinal Data:*** There is a lack of longitudinal studies tracking children's mathematical development, limiting insights into the evolution of early mathematical thinking and the long-term impacts of teaching strategies.
- ***Teacher Training:*** Limited research examines training programs that enhance teachers' abilities to foster mathematical thinking in young children.
- ***Parental Involvement:*** Studies often overlook the nuances of parental involvement and its interaction with educational practices, despite its significant influence on early mathematical learning.

- *Technology Integration:* The role of technology in early childhood mathematics learning is underexplored, with insufficient research on the benefits and challenges of digital tools.

Future research should address these gaps through innovative approaches and diverse methodologies:

- *Cross-Cultural Studies:* Conduct cross-cultural comparisons to understand how cultural norms influence early mathematical learning, leading to tailored educational strategies.
- *Longitudinal Impact Studies:* Track children's progress over several years to identify which educational practices have the most significant long-term impacts on mathematical development.
- *Mixed-Methods Approach:* Combine qualitative and quantitative methods for a comprehensive analysis of early mathematical learning.
- *Evaluating Teacher Training:* Design studies to evaluate teacher training programs, focusing on methods that improve teachers' abilities to foster early mathematical thinking.
- *Enhancing Parental Engagement:* Investigate programs that improve parental involvement in early mathematical learning, supporting diverse socioeconomic backgrounds and examining their influence on children's math skills.
- *Technology-Based Interventions:* Evaluate technology-based interventions to explore how digital tools complement traditional teaching methods and identify best practices for integration.
- *Practical Intervention Models:* Develop and test intervention models that bridge theoretical insights with practical application, adaptable to various educational contexts.
- *Comprehensive Developmental Factors:* Adopt a holistic approach in future research, considering emotional, social, and physical development alongside cognitive and creative processes.

Addressing these directions will enhance our understanding of early mathematical development and improve educational practices to support young learners effectively.

Conclusion

Key Findings and Theme-Specific Conclusions

Theme 1: Foundations and Cognitive Development

- Findings: Early math skills correlate with foundational cognitive processes, such as memory and attention, supported by Piaget's stages of cognitive development. Math anxiety and motivation impact young learners' attitudes and engagement,

while tactile and visual methods enhance early numeracy skills by helping children develop mental representations of numbers.

- **Conclusion:** These findings underscore the necessity for early math programs to integrate cognitive development strategies, emphasizing supportive, hands-on learning to foster foundational skills and mitigate anxiety that may hinder long-term mathematical growth.

Theme 2: Curriculum Design and Instructional Strategies

- **Findings:** Effective early math education leverages interdisciplinary methods, combining subjects like art and science, and embraces play-based and storytelling strategies to teach abstract concepts through relatable experiences. Constructivist approaches allow active learning, while tailored interventions address diverse learning needs.
- **Conclusion:** A well-rounded early childhood math curriculum should integrate interdisciplinary and play-based methods, supporting cognitive, social, and emotional development while ensuring inclusive learning environments that cater to various developmental needs.

Theme 3: Technology and Environmental Influences

- **Findings:** Digital tools, including educational apps and interactive whiteboards, enhance engagement by making abstract math concepts more accessible. The classroom atmosphere, combined with hands-on resources, positively impacts children's motivation and reduces math anxiety.
- **Conclusion:** Integrating digital resources in early math education offers new avenues for engagement and understanding, and should be complemented by supportive, resource-rich classroom environments that consider students' cultural and socioeconomic backgrounds.

Theme 4: Community Engagement and Professional Development

- **Findings:** Parental involvement, including math-related activities at home, enhances children's numerical skills, while teachers' competencies in early math instruction benefit significantly from professional development. Addressing math anxiety through targeted strategies encourages positive math engagement.
- **Conclusion:** Effective early math education relies on the collaborative efforts of parents, educators, and communities, emphasizing the need for continuous professional development to equip teachers with skills to foster positive attitudes and support diverse student needs.

Theme 5: Global Trends and Ethical Perspectives

- **Findings:** Global education benchmarks influence local practices, but over-standardization poses risks. Ethical considerations in math education stress equity, inclusion, and fair assessments to ensure all students access quality math learning.

- **Conclusion:** Educators and policymakers must balance global standards with culturally responsive practices, fostering equitable and inclusive math education by employing fair assessment practices and addressing cultural and socioeconomic differences.

Theme 6: Challenges and Opportunities

- **Findings:** Challenges include assessing early math skills, adapting instruction for diverse needs, and integrating technology effectively. Opportunities lie in the daily integration of core math concepts, play-based learning, and leveraging recent research on non-cognitive skills to foster positive math attitudes.
- **Conclusion:** While early childhood math education faces obstacles, embracing adaptive instruction, play-based learning, and technology offers opportunities for fostering an inclusive and engaging environment that builds a strong foundation for lifelong math success.

Limitations of the Study

This study has presented a thorough analysis and synthesis of the existing research literature on mathematical thinking and learning in early childhood. However, it is not without limitations. Recognizing the study's limitations will help understand its scope and identify areas for future research:

Scope and Generalizability

- *Limited Cultural Contexts*: The study mainly draws from Western contexts, which may limit its generalizability to non-Western settings.
- *Focus on Qualitative Analysis*: Lacking quantitative data, the study may not capture the full spectrum of early childhood math learning experiences.

Methodological Constraints

- *Selection Bias in Literature Review*: Relying on existing literature may introduce biases based on selection criteria and database scope.
- *Lack of Longitudinal Data*: The study emphasizes the need for longitudinal research but does not include such data.

Practical and Implementation Challenges

- *Application in Diverse Settings*: Recommendations may face implementation challenges in under-resourced or differently structured educational environments.
- *Focus on Cognitive and Creative Processes*: Other critical factors, such as emotional, social, and physical development, are not fully addressed.
- *Intervention Strategies*: While suggesting interventions for math anxiety, the study lacks detailed, tested models for practical implementation.

Future research can build on this study's findings by addressing these limitations, contributing to a more comprehensive understanding of early childhood mathematical learning and enhancing educational practices globally.

Recommendations

Effective early childhood math education policies should focus on equity, customized assessments, and improved teacher training. These recommendations aim to provide educational equity, responsible technology use, and culturally responsive curricula.

Recommendations for Policy

- ***Promote Equity and Inclusion:*** Ensure equal access to quality math education, fund programs for disadvantaged communities, implement culturally responsive curricula, and provide targeted interventions for at-risk students.
- ***Standardize but Customize Assessments:*** Design standardized assessments that accommodate diverse learning needs and offer insights for tailored instruction.
- ***Enhance Teacher Training Programs:*** Support comprehensive teacher training that focuses on cultural competence, adaptive strategies, and effective use of classroom technology.

Recommendations for Practice

Recommendations for practice address the classroom environment. The classroom should be structured for engagement, exploration, and skill-building to foster early mathematical thinking. Here are practical suggestions for implementation:

- ***Incorporate Play-Based Learning:*** Set up math stations with toys like blocks and puzzles to encourage sorting, counting, and constructing.
- ***Math-Integrated Daily Routines:*** Use daily activities like attendance and snack time to practice counting, addition, and fractions.
- ***Mathematical Language:*** Use math vocabulary in everyday conversations and encourage students to explain their reasoning.
- ***Real-World Problem Solving:*** Present practical problems that require math, such as measuring plant growth or estimating quantities.
- ***Guided Math Discussions:*** Foster peer discussions on math ideas and problem-solving approaches.
- ***Visual Aids and Manipulatives:*** Provide tools like number lines and geometric shapes to represent abstract ideas tangibly.
- ***Storybooks and Songs:*** Engage children with storybooks and songs incorporating math concepts like counting and patterns.
- ***Scaffolded Instruction:*** Break tasks into manageable steps and offer individualized or small group instruction.
- ***Parent and Caregiver Involvement:*** Share strategies for continuing math learning at home and suggest related games and activities.

- ***Assessment and Feedback:*** Use formative assessments and provide constructive feedback to encourage growth and learning from mistakes.

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Genişletilmiş Türkçe Özet

Giriş

Bu çalışmanın amacı, erken çocukluk döneminde matematiksel düşünme ve öğrenmeye dair güncel araştırmaları sentezleyerek, etkili öğretim metotlarını belirlemek ve bu alandaki bilgi birikimini sentezlemektir. Jean Piaget'in bilişsel gelişim teorisi, çocukların matematiksel düşünme becerilerinin farklı aşamalarını açıklamaktadır. Bu bağlamda, erken sayısal becerilerin gelişiminde ev ortamının ve ebeveyn katılımının rolü önemlidir. Matematik kaygısı ve motivasyon gibi duygusal ve motivasyonel faktörler, çocukların matematikteki başarısını etkileyen kritik unsurlardır.

Yöntem

Bu çalışma, erken çocukluk dönemindeki matematiksel öğrenme üzerine yapılan araştırmaları tematik bir yapı altında analiz edip bunun sonucunda bütünsel bir sentez sunmaktadır. Bu yaklaşım, bilişsel süreçleri ve matematiksel yetenek ile yaratıcı düşünme arasındaki etkileşimi kapsamlı bir şekilde açıklamayı amaçlamaktadır. Tematik sentez, mevcut araştırmaları kategorize ederek, ana temaları ve eksiklikleri belirlemeyi sağlar.

Kodlayıcı güvenirliğini sağlamak için tek bir araştırmacı tarafından gerçekleştirilen bu çalışmada, Thomas ve Harden'in (2008) üç aşamalı tematik sentez süreci izlenmiştir. Kodlama sürecinde, araştırmacı, güvenirliği artırmak amacıyla **refleksif günlük** yöntemi kullanarak kodlama kararları, yorumlar ve karşılaşılan belirsizlikler hakkında detaylı notlar almıştır. Bu refleksif yaklaşım, kodlama sürecindeki olası önyargıların farkına varılmasını ve sistematik olarak ele alınmasını sağlamıştır.

Bu sürecin adımları şu şekildedir:

- **Metnin Kodlanması**: Veriler, önemli ifadeler ve kavramları belirlemek amacıyla satır satır okunarak analiz edilmiştir. Kodlama işlemi sırasında araştırmacı, yorumlarını ve gözlemlerini refleksif günlükte kaydederek kodlama sürecinin şeffaflığını ve tutarlılığını sağlamak için adımlar atmıştır.

- **Tanımlayıcı Temaların Geliştirilmesi**: Kodlar, erken çocukluk dönemindeki matematiksel öğrenme ile ilgili daha geniş temaları tanımlamak için gruplanmıştır. Kodlamada tutarlılık sağlamak amacıyla araştırmacı, kodları orijinal verilerle tekrar karşılaştırmış ve verilerin anlamını yansıttıklarından emin olmuştur.

- **Analitik Temaların Oluşturulması**: Tanımlayıcı temalardan hareketle daha üst düzeyde analitik temalar geliştirilmiştir. Araştırmacı, bu aşamada bir meslektaşı ile **akran değerlendirmesi** yaparak temaların tutarlılığını ve çalışmanın amaçlarıyla uyumunu sağlamıştır. Akran değerlendirmesi, analitik temaların verilerle uyumlu ve mantıksal olarak çıkarıldığını doğrulamak için ek bir güvenlik katmanı sunmuştur.

Bu adımlar, tematik sentez sürecinin güvenirliğini ve tutarlılığını güçlendirmiştir. Böylece, tek araştırmacı tarafından yürütülen çalışmanın sistematik ve güvenilir bir veri analizi sağlaması hedeflenmiştir.

Bulgular

Erken çocukluk döneminde matematiksel düşünme becerilerinin gelişimi, gelecekteki akademik başarı ve bilişsel gelişim açısından kritik öneme sahiptir. Bu çalışma, erken yaş matematik eğitimi üzerine yapılan araştırmaları analiz ederek bilişsel gelişim, müfredat tasarımı, teknoloji kullanımı ve çevresel faktörler gibi ana temalar altında toplamakta ve öğretmenler ile eğitimcilere yönelik stratejik çıkarımlar sunmaktadır.

Elde edilen bulgular, oyun temelli öğrenme, disiplinler arası yaklaşımlar ve aile katılımının matematiksel gelişime katkı sağladığını göstermektedir. Bu kapsamda, çalışmanın bulguları öğretmenlerin matematik eğitimi stratejilerini zenginleştirip çocukların matematiğe karşı olumlu bir tutum geliştirmelerine destek olacak pratik öneriler sunmaktadır.

Bulgular aşağıdaki biçimde altı tema altında gruplanmıştır:

- **Temel Bilişsel Gelişim:** Matematiksel beceriler, Piaget'in gelişim aşamalarıyla paralel olarak bilişsel süreçlerle yakından ilişkilidir. Çalışmalar, kaygı ve motivasyonun matematikle ilgiyi etkilediğini göstermektedir. Somut materyaller, çocukların soyut düşünceye geçişini destekler. Matematik eğitiminin temelleri, bilişsel ve duygusal becerilere dayandırılarak, kaygıyı azaltmak ve motivasyonu artırmak üzerine kurulmalıdır.

- **Müfredat ve Öğretim Stratejileri:** Oyun temelli ve disiplinler arası yaklaşımlar, erken yaş matematik eğitimi için önemlidir. Hikâye anlatımı, oyunlar ve somut materyaller kullanılarak soyut kavramlar somut hale getirilir. İyi tasarlanmış bir müfredat, çocukların matematiksel anlayışını güçlendirerek kapsayıcı bir öğrenme ortamı yaratır.

- **Teknoloji ve Çevresel Etkiler:** Dijital araçlar ve interaktif sınıf materyalleri, kişiselleştirilmiş öğrenme imkânı sunarak motivasyonu artırır. Destekleyici bir sınıf atmosferi, çocukların matematik kaygısını azaltmada etkili olur. Teknoloji destekli, materyal açısından zengin sınıflar matematik öğrenimini teşvik eder.

- **Toplum ve Mesleki Gelişim:** Aile desteği, matematiksel becerilerin gelişiminde kritik rol oynar. Öğretmenlerin mesleki gelişimi, kültürel duyarlılık ve etkili öğretim stratejileri ile desteklenmelidir. Aile katılımı ve öğretmen eğitimi, erken yaş matematik başarısını artırmada hayati önem taşır.

- **Küresel Eğilimler ve Etik Perspektifler:** Uluslararası standartlar yerel uygulamaları etkiler, ancak kültürel duyarlılık önemlidir. Etik ilkelere bağlı kalarak eşitlikçi

eğitim sağlanmalıdır. Eğitimde kültürel uyum ve etik veri kullanımı, kapsayıcı matematik eğitimi için elzemdir.

Zorluklar ve Fırsatlar: Matematik eğitimindeki zorluklar arasında değerlendirme ve bireyselleştirilmiş öğretim bulunur. Oyun temelli öğrenme ve günlük hayatla ilişkilendirme, olumlu matematik tutumu geliştirmeye yardımcı olur. Zorlukların üstesinden gelmek için uyarlanabilir öğretim ve günlük yaşantıya entegre matematik eğitimine odaklanılmalıdır.

Sonuç

Bu çalışma, erken çocukluk dönemi matematik eğitim politikalarının eşitlik ve kapsayıcılığı artırılması, öğrenme süreci ile ilgili değerlendirmelerin standartlaştırılırken bireyselleştirmesi, ve öğretmen eğitim programlarını geliştirmesi gerektiğini vurgulamaktadır. Sınıf ortamı, çocukların matematiksel düşünme becerilerini geliştirecek şekilde yapılandırılmalıdır. Bu bağlamda, ebeveyn ve öğretmenlerin iş birliği, çocukların matematik becerilerini güçlendirmekte ve öğrenmeye olan ilgilerini artırmaktadır. Gelecek araştırmalar, uzun vadeli etkileri anlamak ve çeşitli kültürel bağlamlarda en iyi uygulamaları belirlemek için kesitsel ve boylamsal çalışmalara odaklanmalıdır.

Özetle, erken çocukluk matematik eğitimi, çocukların bilişsel, duygusal ve motivasyonel gelişimlerini destekleyen bütünsel bir yaklaşımla ele alınmalıdır. Matematik kaygısını azaltan ve motivasyonu artıran stratejiler, çocukların matematikle ilgili olumlu tutumlar geliştirmelerine ve başarılı olmalarına yardımcı olacaktır. Disiplinlerarası yaklaşımlar ve oyun temelli öğrenme, çocukların matematiksel kavramları daha iyi anlamalarını sağlayarak, STEM alanlarında cinsiyet eşitliğini teşvik edecektir. Teknoloji ve çevresel faktörlerin etkili kullanımı, öğrenme deneyimlerini zenginleştirerek, çocukların matematik becerilerini geliştirmelerine katkıda bulunacaktır.

Bu nedenle, erken çocukluk matematik eğitim politikaları ve uygulamaları, çocukların gelecekteki akademik başarılarını desteklemek için eşitlikçi ve kapsayıcı bir yaklaşım benimsemelidir. Eğitimcilerin profesyonel gelişimi, öğretim stratejilerinin etkililiğini artıracak ve çocukların öğrenme deneyimlerini daha zengin hale getirecektir. Ebeveynlerin ve toplulukların katılımı, çocukların matematiksel düşünme becerilerini desteklemekte ve öğrenmeye olan ilgilerini artırmaktadır. Bu bütünsel yaklaşım, her çocuğun kendi potansiyelini hayata geçirmesine olanak tanıyacaktır.

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Examination of Early Childhood Teachers' Techniques to Recognize and Assess the Child Before and During the Distance Education

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Abstract: The objective of this study was to examine the recognition and assessment techniques employed by early childhood teachers both prior to and following the pandemic, utilizing a fundamental qualitative research methodology. 17 early childhood teachers participated in the study using a semi-structured interview form. The study's conclusions are arranged according to several themes. The methods early childhood teachers employ to recognize and assess the child during in-person instruction is the first of these themes. During face-to-face education, teachers used various techniques to get to recognize and assess children, including observation, developmental observation forms, developmental reports, warm-up games, drawing, working with families, anecdotes, sociometry, and portfolio work. However, through the pandemic, it was observed that they started using techniques such as interviews, post-activities assessment, observation, and teacher cooperation. The sudden switch to online education-assessment techniques in the distance education process has resulted in unanticipated challenges and situations for the early childhood teachers as they attempt to implement the teaching process. In this context, inclusive training can be provided to teachers on how to get to know and assess children, covering various situations comprehensively.

Keywords: early childhood; teachers; distance education; recognizing; assessment.

About the Article

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Introduction

Amid the Covid-19 pandemic process, millions of students and teachers have initiated the process of distance learning (Aktan Acar et al., 2021). Along with the teaching process, teachers also need to explore novel methods to evaluate the children's learning process. Burgess and Sievertsen (2020) stated that during this educational process, assessments were carried out with some uncertainties and in various ways, which contributed to increased complexity in education. Consequently, the contentious digital and online evaluation techniques for young children have been rigorously scrutinized during this one-of-a-kind period of early childhood distance education. Early childhood teachers have been involved in this nascent experience and practice of employing online assessment methods for young children, lacking adequate training or preparation for online education. As anticipated, these teachers may have encountered numerous challenges, issues, and barriers during this unforeseen experiment. Naturally and predictably, these teachers might have run across numerous challenges, issues, and barriers during this unforeseen experiment. In a study conducted by Akşin Yavuz (2022), it was determined that early childhood teachers conducting online live lessons during distance education mostly did not evaluate the activities they implemented in these live sessions. The National Association for the Education of Young Children (NAEYC, 2004) delineates the rationale for assessing young children in educational settings. Education of children is to make sound decisions for the teaching process, to early intervention be able to recognize children in need and identify special situations and assist program development with educational and developmental interventions is to be. The assessment process is one of the most important components of the learning process, serving as a pivotal evaluation method within education. The assessment findings can serve as a reference point to ascertain the achievement of the curriculum's stated learning objective. The assessment findings can serve as a reference point to ascertain the achievement of the curriculum's stated learning objective. In this context, assessment is also used to measure the extent to which learning objectives have been met. Although each measurement tool serves a distinct purpose, they all fundamentally aim to support the child's development in all aspects (Mindes, 2003). Early childhood is a critical period requiring guidance and direction for self-development, necessitating methods to provide developmental stimulation to identify relevant evaluations (Widat et al., 2022).

The pandemic posed several challenges for teachers who were inadequately prepared for remote teaching, including deficiencies in pre- and in-service trainings to meet the educational needs of young children from a distance, unpreparedness for transitioning from in-person to remote teaching, and the requirement to collaborate with other teachers and partners who sometimes lacked the necessary skills to support them (Chroust et al., 2023). During the pandemic, within the context of distance education, teaching techniques and the methods employed by teachers to recognize and assess children underwent significant changes. One of the researches indicates that there is limited understanding of how teachers evaluate what children already know and can do with technology and it involves early childhood teachers analyzing how teachers assess

young children's technological learning. The study demonstrates a widespread lack of teacher understanding of assessment procedures and assessment data, hindering early childhood programs' ability to accurately monitor the technological progress of young children. The most efficient methods for early childhood teachers to acquire and evaluate data related to technology are proposed (Ntuli, & Kyei-Blankson, 2012). When examining the early childhood education stage, it is seen that informal methods are predominantly utilized in natural settings. Moreover, early childhood teachers employ an alternative assessment technique that encourages active child participation and utilizes a variety of tools such play-based or program-based, dynamic, and portfolio assessments. These asseessment techniques depict the development and learning processes as encompassing both outcomes and ongoing learning (Riley et al., 2016). Additionally, one research finding indicates that a majority of teachers frequently employ observation forms and similar methods and many of early childhood teachers' competencies in recognizing and assessing children are average or below average (Banerjee and Luckner, 2013). It was also found that the limited assessment methods preferred and the lack of knowledge about evaluation were evident in the child assessment practices of the teachers (Işıkoğlu Erdoğan et al., 2021).

A computerized assessment system has been implemented to track, evaluate, guide, and foster the development of young children in alignment with the goals and topics outlined in the Ministry of National Education Vision (MEB, 2018). Therefore, it is acknowledged that our nation is conducting assessments, monitoring, and providing support tailored to each child's unique qualities, interests and developmental levels, which are increasingly crucial in the 21st-century. Furthermore, the use of digital assessment tools in education as a means of assessment have been highlighted within the context of the ISTE (International Society for Technology in Education) criteria for 21st-century skills. Delivering the assessment was challenging, but more importantly, both are necessary for effective education. In the study conducted by Balaman and Hanbay Tiryaki (2021), it was observed that teachers faced challenges in assessment during the Covid-19 period and that there was a need for in-service training programs for teachers. In their specific investigation of assessment techniques for digital competence in education, Sillat et al. (2021) found that assessment tools are predominant, yet proper assessment approaches are not well guided. Due to its frequent quantitative usage, it is now imperative to investigate the effectiveness of its qualitative application. Therefore, the crucial question is whether employing online assessment techniques to analyze children's performance is as beneficial as using the more traditional forms that educational institutions have long employed (Beringuela, 2009). Ali and others (2021) state that the implementation of online assessment has brought several challenges, with a primary concern being the adaptation to using internet resources that diverge from traditional educational practices. Another argument is that technology and online tools are being adopted too belatedly, and had they been utilized earlier, this process would have been modernized and revolutionized, thereby facilitating their current ease of use. Using digital assessment tools in early childhood education settings in light of the digitalization trend indicate that early childhood teachers have difficulty effectively incorporating child-centered

pedagogy, including digital portfolios and such assessment techniques into their curricula (Alanko et al., 2019). As a result, it is believed that teachers faced difficulties in recognizing and assessing children using technological tools during the transition to distance education in the pandemic period. In the literature, there are many researches that examine the assessment methods and instruments of early childhood teachers (Akman et al., 2022; Brown & Rolfe, 2005; Kaya, 2018; Kwi-Ok & Jung-In, 2011; Pretti-Frontczak et al., 2002; Pyle & DeLuca, 2017; Yılmaz Topuz & Erbil Kaya, 2016). In a related study, data were collected from early childhood teachers through questionnaires. It was found that the teachers perceived themselves as competent in using child recognition and assessment methods. They predominantly employed observation and interview techniques, yet some did not adequately respond to questions on developmental assessment tests, leaving answers incomplete (Taner, 2005).

A review of the literature reveals studies where teachers have employed authentic assessment methods, such as observation, interviews, portfolios, play, and checklists, during face-to-face education. The developmental report and the play are not used as assessment method in distance education period (Akman et al., 2022). In early childhood education, documentation is commonly viewed as a tool to improve the standard of care and instruction as well as a technique to consider the viewpoint of the child. There are various formats for techniques to recognize and assess the child, recording and paying attention to the children, assessment and documentation dilemmas, and increase the children's involvement during the process (Alasuutari et al., 2014). Providing the teacher and the learning process with the most suitable time, location, and circumstances is never easy. This is because it should incorporate teaching and learning principles that cover a wide range of topics, including the choice of teaching strategies, the learning environment, the instructional materials, and one of them is assessment (Hartatik, & Fulka Bia'yuni, 2020). These studies have explored assessment techniques of the teachers in the early childhood period. All these studies show that early childhood teachers know different assessment techniques, but they cannot use all these techniques to assess children in the distance education process and they need to make changes. Recognizing and promoting children's growth requires a thorough understanding of and assessment of them. Teachers can facilitate the growth of areas that need support by conducting systematic assessments to determine the developmental stages, interests, and areas of strength of the children. Through assessment activities, teachers can examine the success of their plans and methods of instruction and make appropriate adjustments. Considering this, assessment in the classroom is crucial in both in-person and virtual learning environments.

During the Covid-19 pandemic, sudden shift to online education and assessment procedures has introduced new and unexpected situations and challenges to the educational process and the implementations by the teachers. Under such unforeseen circumstances, it is imperative to examine the strategies employed by early childhood teachers to recognize and assess the children in this period. Furthermore, it is of paramount theoretical importance to understand teachers' assessment techniques concerning young children's online learning during the Covid-19 lockdown, as it

pertains to innovative educational approaches. Therefore, this unprecedented situation has provided context for investigating teachers' views and practices regarding the assessment of children during the period of distance education.

This study aims to address the following research questions;

- What were the children recognizing and assessment techniques of the early childhood teachers before the pandemic (Before March 2020)?
- What were the children recognizing and assessment techniques of the early childhood teachers during the pandemic (March 2020-September 2021)?
- What are the suggestions of early childhood teachers regarding the recognition and assessment of children during distance education?

Method

Research Design

This study was designed as a basic qualitative research method to determine what were the child recognizing and assessment techniques of the early childhood teachers used before and the during the pandemic. Qualitative research involves the process of realistically and comprehensively portraying events within their natural settings, utilizing data collection techniques such as interviews, observations, and document analysis (Creswell, 2013).

Participants

Purposeful sampling method was used to determine the participants, employing criterion sampling. Criterion sampling is used to identify specific situations, objects, or events that meet predetermined criteria (Gall et al., 2007). In this context, the criteria for participation included actively serving as an early childhood teacher both before and during the pandemic and after the pandemic, as well as conducting distance education during the pandemic. Based on these criteria, 17 early childhood teachers from independent kindergartens voluntarily participated in the study. All the teachers participating in the study are women. While the average age of 17 teachers is 31; the average professional seniority is around nine years.

Data Collection and Analysis

To gain a deeper knowledge of early childhood teachers' views, and practices throughout their assessment techniques, as well as teachers' in-practice experiences in early childhood education settings, all qualitative data are gathered through individual interviews. Following the literature and gathering opinions two expert from the department of early childhood education, a semi-structured interview form was developed. Semi-structured interviewing is a technique where the sequence and structure of questions asked during the interview can be altered by the interviewer, and details on

specific topics can be explored (Yıldırım & Şimşek, 2021). Some of the questions from the 12-question interview form are as follow:

- What comes to mind when you think about recognizing and assessing a child?
- What kinds of activities did you conduct to recognize and assess children before the pandemic?
- What kind of activities did you conduct to recognize and assess children during the distance education process necessitated the pandemic?
- What alternative methods and techniques could you have employed during the distance education process?
- Did you collaborate with families in recognizing and assessing children during the remote education process? If so, how?

Before data collection, two pilot interviews were conducted with teachers and it was seen that questions were relevant and comprehensible. Following the pilot process, the interviews were conducted between May and June 2022. All interviews were held face-to-face in a quiet environment at the teachers' schools by one of the researchers. The interviews lasted an average of 30 minutes for each teacher. The data were recorded using a voice recorder. Informed consent was obtained from all participating teachers prior to data collection.

Descriptive analysis technique was used to analyse the data of the study. The data obtained from the research were analysed in four different stages. The first stage of the process is the coding of the data. At this stage, the researchers analysed the data they collected and divided them into meaningful segments and aimed to determine which concept each segment represented. The second stage is the determination of categories and themes. At this stage, the codes were used to identify general themes that could describe the data set at a broader level and to group the codes under specific categories. The third stage of the analysis involved organising the data according to the codes, categories and themes previously identified. In addition, the fourth and final stage of the analysis involved attributing meaning to the collected data, explaining the relationships between the findings, establishing cause-effect relationships, drawing conclusions from the findings and making explanations about the importance of the results obtained.

Ethical Issues and Trusthworthiness

In this study, the researchers followed a series of ethical principles from the beginning to the end of the study. First, before the collection of the research data, research permission was obtained from the İstanbul Kültür University Ethics Committee with the decision numbered 2022/59. Before the interviews were conducted, the purpose and content of the study were explained to the participants and their verbal and written consents were obtained separately for both participation in the study and voice recording on a voluntary basis. Their verbal consent was obtained during the voice recording and their written consent was obtained through the Informed Consent Form. At the approval stage,

participants were informed about their rights to 'freedom of withdrawal', 'confidentiality', 'anonymity' and 'privacy' (Creswell, 2013).

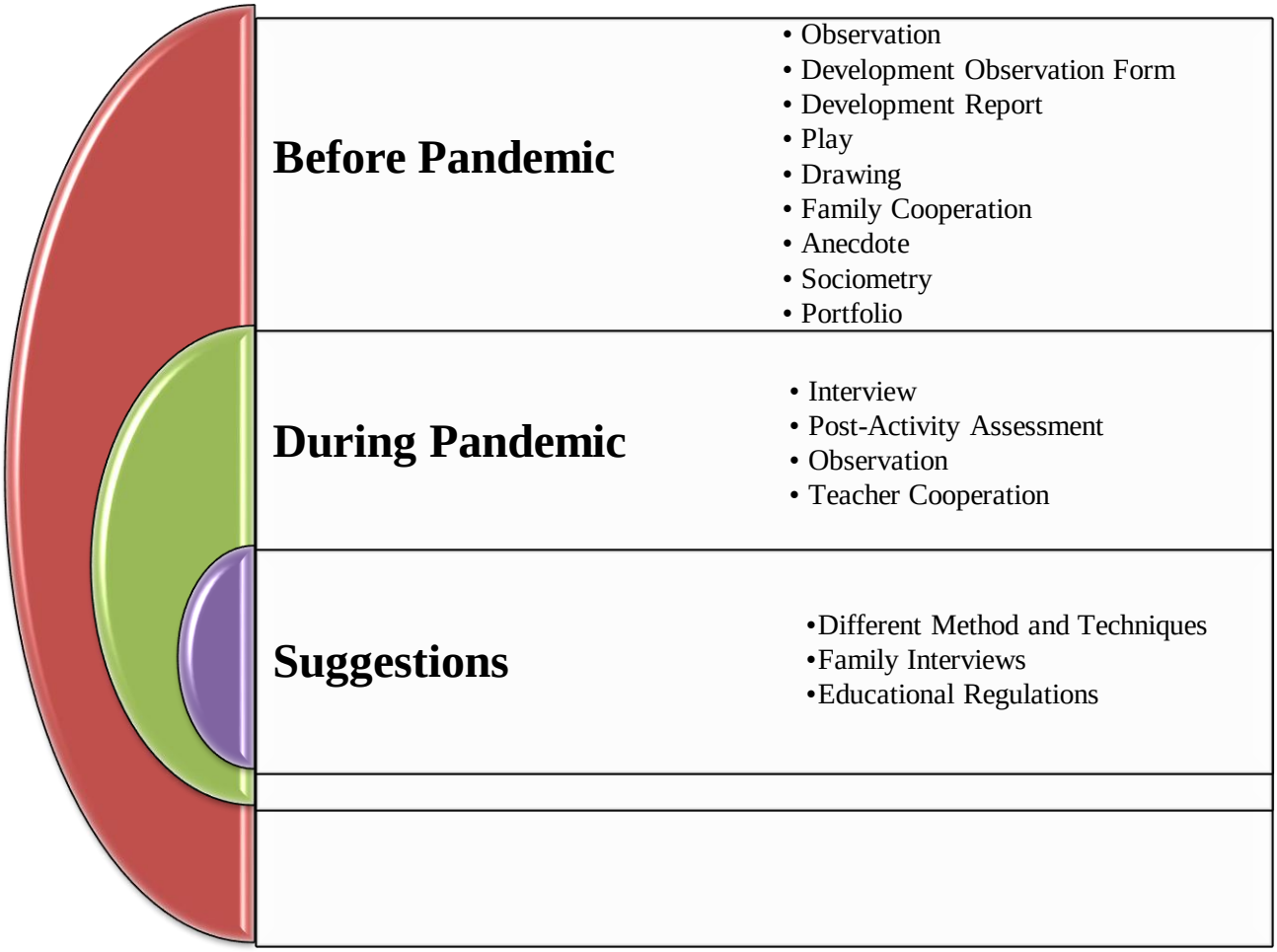
To increase the credibility of the study, data collection started after the research permission was obtained. Before the data collection, the researchers conducted a literature review and created a semi-structured interview form; the interview form was finalised after expert opinions and pilot applications. After the research data were collected, the audio recordings were listened to and transcribed without any changes. In the data analysis phase, the principle of 'consensus among coders' was adopted. In this context, firstly, two transcripts were coded together by two researchers and then presented to the other researchers for their opinions. After all researchers agreed on the first two transcripts, two researchers analysed all the transcripts together and the process was finalised after all researchers gave their opinions on the final version. On the other hand, the fact that one of the researchers who conducted the first analysis phase of the research conducted his own master's and doctoral theses with qualitative methodology and taught qualitative research course at postgraduate level can be considered as the principle of 'long-term participation' from the credibility principles. Finally, another principle, the principle of 'rich and intensive description' enabled the readers to decide on the transferability.

Findings

The aim of the study is to examine the techniques utilized by early childhood teachers in recognizing and assessing children during distance education. The findings of the study are presented under specific themes. The first of these themes is the techniques used by early childhood teachers to get to recognize and assess the child during face-to-face education before the pandemic. When examining the techniques employed by teachers before pandemic during face-to-face education to get to recognize and assess the child, it is observed that they engage in activities such as observation, developmental observation forms, developmental reports, warm-up games, drawing, collaboration with families, anecdotes, sociometry, and portfolio work. When indicated the other theme during pandemic, teachers interview, conduct post-activity assessment, observation and teacher cooperation. Considering recognition and assess tehniques, teachers suggest using different methods and techniques, family interviews and educational regulations to assess the children. The findings obtained are presented in this section. The data has been analysed, and it is supported by direct quotations from the participants.

Figure 1. presents the findings regarding the techniques employed by teachers in getting to recognize and assess the child before and during pandemic.

Figure 1. The techniques used by early childhood teachers in getting to recognize and assessing the child before pandemic and during pandemic.



The Techniques Used in Recognizing and Assessing the Child Before Pandemic

The findings of the study are presented under specific themes. The first of these themes is the techniques used by early childhood teachers to get to recognize and assess the child during face-to-face education before the pandemic. When examining the techniques employed by teachers before pandemicto get to recognize and assess the child, it is observed that they engage in activities such as observation, development observation forms, development reports, warm-up games, drawing, collaboration with families, anecdotes, sociometry, and portfolio work. Examples of raw data related to these subthemes are provided below.

Upon examining the expressions regarding the techniques used by teachers to get to recognize and assess the child during face-to-face education before pandemic, most of them indicated that they conduct observations. The teacher expressed the following regarding observation before pandemic:

T14: "...to recognize the child, the first thing that comes to mind is a teacher's capacity for observation, their observational skills. I can say that the more developed a teacher's observational skills are, the more effective and in control they are in the classroom. Here, by utilizing observational skills, teachers can understand the child to what extent, behaviourally what kind of child they are, what characteristics they possess, and how they interact with their peers. These are the aspects we focus on during classroom processes.''

It can be said that the development of teachers' observation skills is important for recognizing the children in the classroom and assessing them in a way that aligns with their developmental needs.

It has been determined that one-fourth of the teachers during face-to-face education period before pandemic utilize developmental observation forms and developmental reports in getting to recognize and assess the child. The opinions of teachers T1 and T9 regarding this matter are as follows:

T1: "...moreover, I provide examples on developmental observation forms for each developmental domain. For instance, at the beginning of the term, I document incidents such as when my student Poyraz hit his friend, or when İrem was initially seen conversing with an imaginary friend. These instances are recorded on the forms in September, November, March, and June... I offer these examples to illustrate how our student is currently integrating well with peers and has evolved into a more sociable individual. I make a concerted effort to utilize these forms throughout the academic year, as I genuinely value the assessment process.''

T9: "When evaluating the developmental reports for the first and second terms, I categorize their progress based on months and by the end of the term, indicating whether they can fully perform in certain areas or if they still require support."

During the face-to-face education period before the pandemic, it was observed that teachers used developmental observation forms and developmental reports to monitor children's progress throughout the process.

It has been observed that only a small fraction of teachers utilize play and drawing in getting to recognize and assess the child before pandemic. T12 and T14 exemplify this as follows:

T12: "For instance, I engage in activities such as introducing children using puppets. When they exhibit shy behaviour, I adjust my voice tone accordingly while using puppet materials to interact with them in a more engaging manner."

T14: "One of the most commonly used methods is drawing. Personally, I conduct individual sessions with the child and utilize drawing activities as a means of analysis."

It is known that children express themselves through play and drawings. It has been observed that teachers also used play and drawing to analyze and interact directly with children before pandemic for recognizing and assessing them. Considering that the classrooms are crowded, and especially because drawing needs to be implemented individually with each child, it is thought that this approach was only observed among a small number of teachers.

During face-to-face education before pandemic, it has been determined that many teachers collaborate with families by conducting parent meetings, while a minority utilize letters. T8 and T1 explained these techniques as follows:

T8: "…I generally aim to meet with each parent individually, especially during the first week of each academic year, to inquire about any special circumstances or ongoing health issues concerning their child. I make a particular effort to conduct these meetings face-to-face to gain a deeper understanding of the child."

T1: "I always make it a point to have parents write a letter describing their child to me. This proves to be immensely helpful for me because while the parents are writing, I specifically ask them to provide detailed information rather than surface-level descriptions such as 'my child is friendly'. I emphasize the importance of elaboration as these details are crucial for me."

It can be stated that family collaboration is important in recognizing and evaluating children. When teachers collaborate with families in various ways, it is believed that families feel valued and help ensure the continuity of education in harmony with the teachers.

It has been observed that only a small percentage of teachers utilize anecdotes, sociometry, and portfolios to recognize and assess the child before pandemic. T5, T17, and T4 expressed their use of these techniques as follows:

T5: "We already constantly record anecdotes within the classroom setting."

T17: "I'm not sure if it's an assessment tool, but I used to conduct small sociometry myself to measure friendship relationships. It involves determining who is popular among peers and who may feel isolated, among other aspects."

T4: "Later, we would observe what the child could accomplish within activities, which were documented through portfolio work. Portfolios served as our primary documents, allowing us to assess their progress by reviewing them."

It is considered important for teachers to use various techniques in the process of recognizing and assessing the children. However, it has been observed that only a small

number of teachers utilize such techniques. It can be stated that it is essential for teachers to receive training on how to implement these techniques.

Techniques Used for Getting to Recognize and Assessing the Child During the Pandemic

Figure 1 indicates that during pandemic through the distance education, teachers utilize techniques such as interviews, post-activity assessments, observations, and collaboration with other teachers for getting to recognize and assess the child.

The majority of teachers have stated that they conduct interviews as part of the process of getting to recognize and assess the child during distance education. T4 expressed it as follows:

T4: "We had the most opportunity for interviews. We had the chance for individual interviews, and we even conducted video calls with families through WhatsApp to get to meet the child from there."

During the pandemic, it can be said that family meetings became particularly important as children spent a lot of time with their families. This way, by engaging in interactive sharing with families, accurate assessments of the child can be made, and the children can be supported effectively.

It has been determined that only a small fraction of teachers utilize post-activity assessments, observation, and collaboration with other teachers as techniques for getting to recognize and assess the children during distance education. The opinions of teacher … regarding this matter are as follows:

T17: "They sometimes self-assess their activities. For instance, when I ask them initially, 'How do you assess yourself? Did you enjoy it? Did you like it?' and so on..."

T10: "In getting to recognize and assessing the children, I attempted to observe and understand what they told me with the support I received from their families."

T7: "Sometimes, we encounter very different children. I find myself saying, 'I've never seen a child like this before.' There are times when I am unsure of what I should do. Of course, we consult each other, exchange ideas, and interact with the child in different ways. So, we communicate."

Post-activity assessment is considered important for recognizing and assessing children. This allows teachers to determine whether the intended learning outcomes of an activity were achieved and what kind of gains were made from the children's perspective. It can be noted that observing children during distance education is not very easy. However, it is believed that it is important for teachers to conduct observations even through screens. Additionally, due to the limited experience of other teachers with distance education, collaboration among teachers is crucial, as they can positively support each other during this process.

Suggestions of the Early Childhood Teachers to Assess Children in Distance Education

It has been identified that if it is necessary in such a situation early childhood teacher offer suggestions regarding various methods and techniques to recognize and assess the children in distance education, including family interviews and educational regulations. T3, T14, and T10 expressed their thoughts as follows:

T3: "For instance, brainstorming or SCAMPER techniques might be more effective. By utilizing these methods, we can observe the child's creativity or self-expression. Through the question-answer technique, we can understand how they express themselves. When I read a story, I can assess their creativity or language development through these means."

T14: "I personally don't believe that a comprehensive assessment of the child can be made without physically interacting with them, without seeing, touching, or being in the same environment as the child. If we must, the most crucial key point remains the parents. Feedback from parents would be decisive. Besides that, I don't think distance education can be very effective during the preschool period."

T10: "I believe that efforts should be made to support in-service training or for teachers to engage in activities aimed at their professional development."

Using various methods and techniques can better capture children's interests during distance education. It has been emphasized that in-service training is essential for teachers to be familiar with these techniques and to conduct distance education effectively. Furthermore, since children spend a lot of time with their families during the distance education process, teachers have also noted the importance of conducting interviews with families.

Results and Discussion

The objective of the study is to examine the techniques employed by early childhood teachers in the recognition and assessment of children before the pandemic and during distance education. The study outlines the assessment methods employed by teachers, with conclusions organized around several themes: those relevant to the periods of face-to-face education before pandemic and distance education during pandemic, as well as teachers' suggestions. In general, the results of the research show that during face-to-face education before the pandemic, early childhood teachers used different child recognition and assessment techniques. These are observation, developmental observation forms, developmental reports, warm-up games, drawing, collaboration with families, anecdotes, sociometry, and portfolio work. All these types of assessment that form the focus of this study is authentic assessment. Upon analysing the authentic assessment techniques employed by the involved teachers, it was noted that face-to-face education before makes use of observation, plays, portfolios, interviews, and

developmental reports. The terms performance assessment and authentic assessment are frequently used in educational research and literature (Palm, 2019). However, during the pandemic through distance education, teachers' methods of recognising and assessing the child have been somewhat restricted, and it is seen that they have continued to use the methods frequently used in early childhood. Through distance education, teachers utilize techniques such as interviews, post-activity assessments, observations, and collaboration with other teachers. In cases of sudden changes such as pandemics, teachers' suggestions regarding their experiences in recognising and assessing children were examined; it was seen that they mentioned the use of different techniques to assess the children comprehensively and suggested obtaining comprehensive assessment data about children by conducting interviews in cooperation with the family, especially through the education processes continuing from home. Reconsidering conventional assessment techniques may be necessary to assess children's learning in the distance education context. To ensure accurate and reliable assessments of children's learning outcomes, institutions should explore alternative assessment techniques such as competency-based assessments, and authentic assessments (Donlon et al., 2020). As mentioned in the research, all these long-term assessment techniquee used to monitor and document children's developmental process offer the opportunity to provide a comprehensive overview of both children's strengths and areas of development (Bagnato, 2007). The first theme pertains to the techniques early childhood teachers employ to recognize and assess children during in-person instruction. During in-person instruction, teachers employ a variety of techniques to recognize and evaluate children, including observation, developmental observation forms, developmental reports, warm-up games, drawing activities, collaboration with families, anecdotal records, sociometric assessments, and portfolio work. As found in this research, Doyle and others (2020) emphasise alternative assessment methods should be explored for accurate and reliable assessment of children's learning outcomes. Also, teachers utilize portfolios to track the complete developmental progression and milestones of children. It is noteworthy to highlight that there are various types of assessments such as standard/authentic formal/informal, prescriptive/descriptive, criterion/norm referenced (Buldu, 2010).

Teachers use techniques including observations, post-activity assessments, interviews, along with collaboration with other teachers to recognize and assess the children during a pandemic through distance education. Before and during the pandemic teacher mention that observation is one of the common techniques to assess the children. Authentic assessment also involves observing children in natural learning environments such as play conducting assessment through meaningful and applicable activities in real-life situations, hands-on activities, and focusing on vital knowledge and skills. As found in this research, distance education has led to difficulties in understanding children's development, because of the restrictions on teachers' one-to-one interaction with children (Kuhfeld & Tarasawa, 2020). Early childhood education programs place significant emphasis on child development assessments. It provides early childhood teachers with a productive means of gathering data on children which makes it possible

to recognize children who have developmental issues (Vazquez Nuttall et al., 1999). Authentic assessment tools consist of anecdotes, checklists, rubrics, rating scales, observations, and portfolios (Akman, 2010; Buldu, 2010) and, it has been revealed that many teachers utilize observation, post-activity assessments, or collaboration with other teachers as methods for recognizing and assessing the children during distance learning. Throughout the pandemic, many educational processes and activities shifted online due to distance education (Godhe, 2024). While assessing young children, early childhood teachers encounter a variety of difficulties. Young children are rapidly growing up, and the distance education process presents numerous challenges. As stated in the teachers' views, it is possible to modify assessment techniques to be more inclusive and effectively relevant by having a better understanding of how educational policies, family involvement, and restrictions affect assessment procedures (OECD, 2013). The learning levels of the children in distance education are significantly influenced by their interactions with their peers and teachers (Sher, 2009). To track their development clearly, the assessment procedures should be repeated frequently and methodically documented. Meaningful assessments of early childhood development during the pandemic, where early childhood teachers must conduct a child development assessment to recognize the child's development and learning during the pandemic using a variety of assessment methods in accordance with early childhood assessment standards (Rochanah, 2021).

Anecdotal notes and authentic assessment compile significant occurrences pertaining to children's attitudes and behaviors in various situations. These notes can serve to assess children's creativity, providing valuable material for ongoing evaluations with the teacher. The sudden shift to online learning and assessment techniques during distance education has introduced new and unforeseen circumstances and obstacles in the implementation of teaching process by teachers. Examining how early childhood education professionals recognize and assess children during these unforeseen circumstances is essential. Regarding the limitations of assessment methods, Su and Yang (2024) also noted that teachers typically rely on a single data collection instrument. Furthermore, as a pivotal study in exploring novel approaches, it is theoretically crucial to understand teachers' assessment methodologies concerning young children's online learning during the distance education. Throughout the distance education process, teachers have identified several assessment techniques, including interviews, post-activity assessments, observations, and cooperation among teachers. Observation has been identified as the most frequently utilized evaluation technique in many studies (Ntuli et al., 2014; Okatan & Tagay, 2021; Yılmaz Topuz & Kaya, 2016). Nonetheless, despite discussions among teachers on enhancing children's learning quality and online assessment, early childhood teachers particularly emphasized the integration and assessment of children's learning and development (Godhe, 2024). However, as outlined in the introduction, in the Ministry of National Education (MEB) 2024 Early Childhood Education Program, the mandatory evaluation tools for assessing children include the developmental observation form, developmental report, and developmental portfolio (MEB, 2024). Documentation is essential for demonstrating accountability and for evaluating and organizing the educational programs and other operations of ECE centers. Ultimately,

child documentation is completed for the benefit of individual children and their families. It is employed to promote parental involvement in early education and to support the growth and learning of children in ECE. These broader objectives for child documentation typically aim to enhance the quality of ECE through collaboration with parents and educational initiatives (OECD, 2012). Furthermore, child documentation can be perceived to deliver personalized early education for each child (Carr & Lee, 2012; Driscoll & Rudge, 2005). Early childhood teachers have been observed to offer guidance on a range of approaches and techniques, including family interviews and educational regulations to help recognize and assess the child during the distance learning. Children's interests can be better addressed during distance education by employing a variety of strategies. It has been underlined that for teachers to properly conduct distance education and be conversant with these techniques. Teachers have also emphasized the value of interviewing families because children spend a lot of time with them during the process of distance education. In their research, Işıkoğlu-Erdoğan et al. (2021) found that many early childhood teachers exhibit competencies in child recognition and assessment that are average or below average. Similarly, study by Banerjee and Luckner (2013) suggest that teachers often prioritize specific methods such as developmental observation forms and various observation tools.

Recommendations

Considering the research results on assessment techniques used by early childhood teachers in both face-to-face education before pandemic and distance learning environments, several recommendations can be made for researchers and teachers. These recommendations aim to address the challenges highlighted in the study and to provide insights into how assessment practices can be improved, particularly in the context of distance learning process.

Future research should explore innovative techniques for studying children's natural behaviors during online activities to enhance the adaptation of authentic assessment techniques in distance education settings. The role of technology in facilitating more valid and reliable assessment techniques, particularly in light of the increasing shift toward digital education, warrants detailed investigation. Researchers should examine how tools such as interactive assessment techniques, digital portfolios, and dynamic data analysis might contribute to the accuracy of children's assessments in virtual learning environments. A key focus of future studies should be on understanding how these technological tools influence teachers' assessment practices and their efficacy in assessing children's development across various domains.

The involvement of parents in the assessment process is particularly crucial in distance education process, where teachers face limitations in direct student observation. Research should explore strategies for effectively engaging parents in this process, encouraging them to share observations, participate in dialogues about their child's

progress, and provide regular feedback on developmental milestones. Moreover, the use of digital portfolios presents a promising method for documenting children's learning trajectories in online settings. These portfolios, which can include multimedia elements such as photographs, videos, audio recordings, and samples of children's work, offer a more dynamic way to track developmental progress over time. Therefore, research should also focus on how teachers can maintain continuous feedback loops with both parents and children to ensure that learning objectives are being met. By systematically recording children's actions, preferences, and developmental stages, teachers can better tailor their educational approaches to support each child's individual development.

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Genişletilmiş Türkçe Özet

Dijital bir değerlendirme sistemi, Millî Eğitim Bakanlığı'nın Eğitim Vizyonu (MEB, 2018) doğrultusunda çocukların izlenmesi, değerlendirilmesi, yönlendirilmesi ve geliştirilmesi amacıyla uygulanmıştır. Bu nedenle, ülkemizin her çocuğun benzersiz özelliklerini, ilgi alanlarını ve gelişim düzeylerini gözlemleyerek değerlendirildiği ve destek sağladığı kabul edilmektedir; bu durum 21. yüzyılda daha da önem kazanmaktadır. Öğretmenlere ve öğrenme sürecine en uygun zaman, yer ve koşulları sağlamak her zaman çaba gerektirmektedir. Bu durumun nedeni, öğretim stratejilerinin seçimi, öğrenme ortamının düzenlenmesi, öğretim materyallerinin kullanımı ve değerlendirme yöntemleri gibi geniş bir yelpazeye yayılan öğretme ve öğrenme ilkelerini içermesidir (Hartatik ve Fulka Bia'yuni, 2020). Bu bağlamda yapılan çalışmalar, özellikle okul öncesi öğretmenlerin değerlendirme tekniklerini incelemiştir. Pandemi ile birlikte uzaktan eğitim sürecine ani geçiş, çevrimiçi öğrenme ve değerlendirme süreçlerinde beklenmedik değişimlere yol açmış ve eğitim süreci ile öğretmenlerin uygulamalarında yeni ve öngörülmemiş durumlar ortaya çıkarmıştır. Bu tür beklenmedik koşullar altında, okul öncesi öğretmenlerinin bu dönemde çocukları tanıma ve değerlendirme tekniklerinin incelenmesi gerekliliği ortaya çıkmıştır. Ayrıca, öğretmenlerin uzaktan eğitim döneminde çocukların çevrimiçi öğrenmelerine yönelik değerlendirme tekniklerini anlamak, yeni yöntemler açısından büyük öneme sahip bir çalışma olarak değerlendirilmektedir. Bu doğrultuda, bu çalışma ile okul öncesi öğretmenlerinin uzaktan eğitim öncesi ve uzaktan eğitim sürecinde çocukları tanıma ve değerlendirme tekniklerinin neler olduğunun ortaya çıkarılması amaçlanmaktadır.

Nitel araştırma yöntemiyle yürütülen bu araştırmada, okul öncesi öğretmenlerinin uzaktan eğitim sürecinde çocuğu tanıma ve değerlendirmede kullandığı tekniklerin belirlenmesi amacıyla görüşme tekniğinden yararlanılmıştır. Bu doğrultuda araştırmacılar tarafından geliştirilmiş olan yarı yapılandırılmış "Öğretmen Görüşme Formu" kullanılmıştır. Görüşme formu için uzman görüşlerine başvurulmuş ve son hali verilmiştir. 17 öğretmenin her biriyle yüz yüze görüşmeler gerçekleştirilmiş ve görüşmeler ses kayıt cihazıyla kaydedilmiştir. Araştırmanın amacı ve içeriği, görüşmeler yapılmadan önce katılımcılara açıklanmış ve ses kaydı alınması için katılımcıların sözlü ve yazılı onamları alınmıştır. Onay sürecinde, katılımcılara araştırmadan çekilme özgürlüğü ve gizlilik hakları hakkında bilgilendirme yapılmıştır. Araştırmada veriler transkript edildikten sonra betimsel yöntemle analiz edilmiştir. İki araştırmacı bağımsız olarak analiz etmiş, kod ve temaları çıkarmıştır. Kod ve temalar belirlendikten sonra öğretmenlerin görüşlerinden direkt alıntılarla desteklenmiştir.

Araştırmada, okul öncesi öğretmenlerinin uzaktan eğitim sürecinde çocuğu tanıma ve değerlendirmede kullandıkları tekniklerin incelenmesi amaçlanmış olup araştırmanın bulguları belirli temalar altında sunulmuştur. Okul öncesi öğretmenlerinin yüz yüze eğitim sürecinde çocukları tanımlama ve değerlendirme yöntemleri, bu temaların ilkini oluşturmaktadır. Öğretmenler, yüz yüze eğitim sürecinde öğrencileri tanımlamak ve değerlendirmek için gözlem, gelişim gözlem formları, gelişim raporları, oyun, resim, ailelerle çalışma, anekdotlar, sosyometri ve portfolyo çalışmaları gibi çeşitli teknikler

kullanmaktadır. Yüz yüze eğitim döneminde çocuğu tanıma ve değerlendirmede aile ile iş birliği kapsamında öğretmenlerin büyük bir çoğunluğunun veli görüşmeleri yaptığı belirlenmiştir. Öğretmenler portfolyo kullanarak çocukların tüm gelişim dönemlerini ve kritik gelişimsel aşamalarını bütüncül bir bakış açısıyla görebilmektedir. Çocuğu değerlendirme sürecinde kullandıkları teknikler arasında standart/özgün, formal/informal, betimleyici/yönlendirici, ölçüt/bağıntı referanslı gibi çeşitli değerlendirme türlerinin mevcut olduğu söylenebilir (Buldu, 2010). Bu çalışmanın odak noktasını oluşturan değerlendirme türü ise özgün değerlendirmedir. Performans değerlendirmesi ve özgün değerlendirme terimleri, eğitim araştırmaları ve literatürde sıklıkla kullanılmaktadır (Palm, 2019). Araştırmada belirtildiği üzere, çocukların gelişim ve öğrenme sürecini izlemek ve belgelemek için kullanılan tüm bu değerlendirme teknikleri, çocukların hem güçlü yönlerine hem de gelişim alanlarına ilişkin kapsamlı bakış fırsatı sağlamaktadır (Bagnato, 2007). Pandeminin başlamasıyla birlikte uzaktan eğitim sürecine geçilmiş ve öğretmenlerin çocukları değerlendirmek için kullandıkları teknikler tamamen değişmemekle birlikte sınırlı hale gelmiştir. Öğretmenlerinin büyük bir çoğunluğu uzaktan eğitim sürecinde çocuğu tanıma ve değerlendirme kapsamında görüşme yaptıklarını belirtmiştir. Uzaktan çalışan öğretmenler çocukları tanıma ve değerlendirme süreçleri için gözlemler, etkinlik sonrası değerlendirmeler, görüşmeler ve diğer eğitimcilerle iş birliği gibi teknikler kullanmaktadır. Okul öncesi öğretmenlerinin uzaktan eğitimde çocuğu tanıma ve değerlendirmeye ilişkin farklı yöntem ve teknikler kullanılması, aile görüşmeleri ve eğitsel düzenlemeler yapılması önerilerinde bulunmuşlardır.

Okul öncesi öğretmenlerinin hem pandemi öncesi yüz yüze eğitimde hem de uzaktan eğitim sürecinde kullandıkları değerlendirme tekniklerine ilişkin araştırma sonuçları göz önünde bulundurulduğunda, araştırmacılar ve öğretmenler için çeşitli önerilerde bulunulabilir. Bu öneriler, çalışmada vurgulanan zorlukları ele almayı ve özellikle uzaktan eğitim süreci bağlamında çocuğu tanıma ve değerlendirme tekniklerinin nasıl geliştirilebileceğine odaklanabilir. Araştırmacılar, dijital eğitimin artan popülaritesini göz önünde bulundurarak uzaktan eğitim süreçlerinde etkileşimli değerlendirme teknikleri ve dijital portfolyolar gibi araçlarla uzaktan eğitimde çocukların gelişim ve öğrenmelerinin nasıl değerlendirilebileceğini, bu teknolojik araçların öğretmenlerin değerlendirme uygulamalarını nasıl etkilediğini ve çocukların öğrenme ve farklı gelişim alanlarını değerlendirmede ne derece etkili olduğunu ortaya çıkarmak üzerine odaklanabilirler.

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A/R/Tographic Investigation into Artistic Development Processes of Undergraduate Art Education Students

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Abstract: This qualitative study investigates the artistic development processes of undergraduate art education students through an a/r/tographic approach, aiming to determine the role of portfolio preparation within these processes. This research, conducted during the 2022-2023 academic year, took place in a workshop course for 4th-year students in the Department of Art and Art Education at a medium-sized university, involving 10 volunteer students. The study group was selected through criterion (purposive) sampling. Data collection included educational development files (portfolios) prepared by students during the inquiry process, a question pool, a/r/tographic reflections gathered through a semi-structured interview form developed with input from field experts, as well as peer and expert evaluations and student artworks produced at the study's conclusion. Qualitative data analysis was employed to examine data related to the a/r/tographic process-an art-based research method. Accordingly, content analysis was used to evaluate student, peer, and expert reviews of the educational development files (portfolios). The students' artistic and a/r/tographic inquiry processes were analyzed using descriptive analysis. Findings indicated that students were generally satisfied with the self-evaluation approach of their educational development files (portfolios). Peers and experts who reviewed these files suggested that, although valuable, the portfolios could be further improved. It was observed that students engaged with the a/r/tographic process both deliberately and incidentally, continuing their exploration through ongoing inquiry. Students also demonstrated varied perspectives through their artist identities, producing process-oriented works that reflected their personal growth and self-expression.

Keywords: Art Education, a/r/tography, educational development file

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Introduction

Education is a process aimed at bringing about desirable behavioral changes in individuals. Senemoğlu (2002) describes it as an investment in human capital, a nurturing of personality, and a means of shaping behavior. Through this process, individuals acquire new behaviors across various domains, and education itself continually evolves alongside developments in multiple fields. Turan (2005) notes that global shifts have influenced societal needs, necessitating societies that value self-renewal and continuous learning. Education is thus a key component of social life and cultural activity, fostering positive attitudes, skills, and development aligned with individual interests, abilities, and societal expectations (Yıldırım, 1987, p.42). In tandem with this evolving educational landscape, art education also adapts and grows. Küçüktepepınar (2014) defines art education as activities that help individuals express their emotions, thoughts, and impressions while enhancing creativity to an aesthetic level. Beginning with children's early drawings, the artistic development process is essential, unfolding through stages that include scribbling, pre-schematic, schematic, and realistic phases. Artut (2004) emphasizes the importance of aligning with these developmental stages, cautioning that imposing direction can limit children's self-expression. Each stage reflects the growth of new perspectives and continued artistic development.

The products that emerge during artistic development are essential for tracking an individual's progress, as they allow one to follow their growth and retain knowledge and skills collectively. Consequently, there is a need to store all artistic works systematically, making educational development files (portfolios) instrumental in this process. Portfolios, widely used today, serve as a means to collect and evaluate the individual's lifelong artistic creations. McMullan (2006) argues that portfolios should be performance-based, reflecting real-life learning with reliable, realistic, and applicable qualities. Originating from the Italian word meaning "portable paper," the portfolio concept has various Turkish equivalents, such as 'product file,' 'product selection file,' 'development file,' or simply 'portfolio.' According to Baki & Birgin (2004), portfolio definitions vary based on usage and purpose, while Alıcı (2008) suggests that when tracking both process and product over a specific period, the term "development file" is most fitting (p.137). In this study, "educational development file" is used alongside "portfolio" to describe a collection of learning products, either on paper or electronically, that systematically assesses the student's growth in specific skills or academic performance. This process involves a planned review of progress in meeting established educational objectives. Stinggins (1994, as cited in Korkmaz & Kaptan, 2003, p.160) notes that portfolios are not assessments but tools to illustrate student development and success. As Rassin, Sinler, and Ehrenfeld (2006), Tiwari & Tang (2003), and Gannon et al. (2001) highlight, portfolios have long been used by professionals like painters and writers to showcase achievements. Nevertheless, this evaluative approach has limitations. Hurwitz & Day (1995) caution that, alone, portfolios may lack the depth needed to capture the intricacies of artistic development and thought processes, making them insufficient as the sole tool in art-based research (p.87).

New art-based approaches are expanding horizons in art education. Şen (2010) notes that art evolves alongside scientific research and development, stating that as branches of science diversify, artistic creations have both increased and become more effective in expressing subject matter within the art field. In art-based approaches, the student is expected to remain active throughout the process. Beattie (1997) describes this process as consisting of in-class activities that are cognitively grounded and that guide artistic work. A/r/tography is one such approach, where meaning-making requires continuous inquiry. "A/r/tography is a research approach involving a living process of inquiry, materializing through artistic and textual expressions rooted in understanding and experience. In this context, inquiries related to objects or forms within the research are ongoing" (Springgay et al., 2008, as cited in Erişti, 2017, p.192). Through the inquiry process, a/r/tography incorporates various emergent approaches that allow researchers to convey their processes. It is based on Aristotle's three dimensions of knowledge: theoria (theory), praxis (practice), and poiesis (creation). Irwin et al. (2006) observe that the first three letters of "a/r/tography" evoke the concept of art, yet the term itself is derived from "artist," "researcher," and "teacher," with "graphy" connecting to the act of writing. This approach reflects not only distinct concepts and roles but also a sense of unity and interconnectedness.

Among these approaches, concepts such as proximity, living inquiry, metaphor and metonymy, openings, reflection/resonance, and surplus are key in uncovering meanings through exploration from diverse perspectives, emphasizing association and emergence. A/r/tography, where the roles of artist, researcher, and educator intersect, is grounded in Deleuze and Guattari's (1987) rhizomatic approach. This approach to a/r/tography involves forming individual connections that yield multiple meanings and differences, all emerging from an organized rhizome, or an openly interconnected structure (Bedir-Erişti, 2019, p.194). As an arts- and practice-based research method, a/r/tography relies on various sources for data, as noted by Başyurt & Taşkesen (2022). These sources document the research process and include journals, photographs, individual experiences, written reflections, and autobiographical narratives. "The artistic production process and the pedagogical process develop and enrich the practice under a shared framework" (Bedir-Erişti, 2021, p.16). As a result, this research method, one of the newer art-based approaches, "holds the potential to uncover and reveal previously unexplored aspects of the a/r/tographic process" (Barney, 2009).

Although practice-oriented studies exist in the field of art education in Turkey, research utilizing the a/r/tography method remains limited. Implementing a/r/tography, an application-oriented, art-based educational research method, is valuable not only for addressing research problems but also for exemplifying diverse methodological approaches in the field. This method is particularly beneficial in helping students recognize the artistic contributions of portfolio preparation, encouraging self-critique, and fostering awareness of their artistic development. In this study, the a/r/tography method is positioned to contribute significantly to art education and art-based practices by promoting its recognition, supporting its development, and expanding the use of portfolios across various domains within art education.

Several studies have explored a/r/tography and the use of educational development file portfolios. Keser and Narin (2017) explained the a/r/tography method, emphasizing the formation of rhizomatic connections and the role of inquiry in research. Güler (2021), through a/r/tographic questioning, encouraged students to critically examine their environments, with thematic insights emerging from focused trip experiences. Demir (2023) examined societal dynamics and perceptions of women's images, exploring gender roles through an a/r/tographic perspective. In their study, Başyurt and Taşkesen (2022) guided students to engage in a/r/tographic inquiries within their unique workshops, producing reflective, self-expressive works. Additionally, Öncü (2009) explored the use of portfolios in assessment and evaluation, while Mamur (2012) discussed portfolios as documentation tools in visual arts education. Mavioğlu (2019) used an a/r/tographic inquiry within visual culture studies to probe subconscious themes. Given this foundation, the current study is anticipated to contribute similarly to the field.

This study aimed to investigate the artistic development processes of undergraduate students in art teacher education through an a/r/tographic approach and to examine the role of portfolio preparation in this process. For this purpose, answers to the following sub-objectives were sought.

1. What are the opinions of undergraduate art education students on their own artistic development processes?
2. How do undergraduate art education students evaluate their peers' artistic development processes?
3. How do experts evaluate the artistic development processes of undergraduate art education students?
4. How did the a/r/tographic inquiry processes progress for undergraduate art education students?
5. How are the artistic products created by the undergraduate students of art-work education at the end of the artographic inquiry process?

Method

Research Model

This research utilized a case study approach, one of the qualitative research methods, drawing on a/r/tographic inquiry from art-based and practice-based research due to its suitability for the study. Qualitative research involves understanding the essence of extensive data by reducing its volume, identifying significant patterns, and creating a logical chain of evidence about the phenomenon under investigation (Patton, 2014). A case study is a methodological approach that entails an in-depth examination of a bounded system, systematically gathering information through multiple data sources to understand how that system functions (Chmiliar, 2010). Art-based a/r/tography is a process of inquiry that provides the researcher with multiple identities, transforming the research into a creative exploration. Through a/r/tographic inquiry, the roles of

researcher, educator, and artist come to the forefront, fostering a dynamic and holistic approach to understanding artistic development.

Working group

The study group for this research comprised 10 volunteer students enrolled in a 4th-year workshop course in the Art Education Department at a medium-sized university during the 2022-2023 academic year. Criterion (purposive) sampling was used to select the participants. "In purposive sampling, the researcher applies their judgment to select participants best suited to the purpose of the research" (Balcı, 2010). For this study, the students were chosen during a period when they had completed their sub-workshop processes, ensuring their suitability for the study's objectives.

Data collection tools

The data for this research included student educational development files (portfolios) prepared during the inquiry process, a/r/tographic reflections, peer and expert evaluations, and student artistic products created at the end of the process. These were gathered through a semi-structured interview form, developed based on input from field experts and a question pool.

Data collection

In the initial stage of this research, sample portfolio presentations were prepared by the researchers and presented to students in a classroom setting, accompanied by sample explanations. Following this, students were asked to create and present their own portfolio presentations. In the next stage, students presented their portfolios to their peers, who then provided evaluative feedback. Afterward, each presenting student was given an artistic development process form designed by the researchers and was asked to evaluate their own artistic process.

In a subsequent stage, the concept of a/r/tographic inquiry was introduced, with examples provided to illustrate the process. Students were then encouraged to engage in inquiries aligned with their a/r/tographic identities as they worked on their original workshop projects. Throughout this stage, a/r/tographic reflections were collected to document the process leading up to the creation of their final workshop products. At the end of the process, students—acting as a/r/tographers—produced original artistic works and were asked to provide written explanations of these creations.

Data analysis

Qualitative data analysis was employed to examine data related to the a/r/tographic process, an art-based research method. "Qualitative data analysis is a process in which the researcher organizes the data, breaks it into units of analysis, synthesizes it, identifies patterns, discovers significant variables, and decides which information to include in the report" (Bogdan & Biklen, 1992). Content analysis was applied to student, peer, and expert evaluations of educational development files (portfolios). As Yıldırım & Şimşek

(2008) explain, "Content analysis involves organizing similar data under specific concepts and themes and interpreting it in a way that readers can easily understand" (p.89). Descriptive analysis was used to examine students' artistic and a/r/tographic questioning processes. According to Sözbilir (2009), descriptive analysis can be structured based on the themes derived from research questions or presented according to the questions or dimensions explored during interviews and observations.

Reliability

The reliability of this research was ensured by having the researchers analyze the data collaboratively and then reanalyze the same data after a specified interval. In this process, the initial and final analyses were compared, and any differences were resolved through consensus.

Findings

This section of the study includes an evaluation of the educational development files (portfolios) prepared by the students, focusing on their artistic development processes. It also incorporates peer and expert evaluations, along with the students' original workshop projects.

As shown in Table 1, in response to the question "When did you start painting?" undergraduate art education students indicated that they began painting in preschool, primary school, secondary school, or during their undergraduate studies.

What are the opinions of undergraduate art education students on their own artistic development process?

Table 1. *Opinions of Undergraduate Art Education Students on Artistic Development Processes*

Theme	Sub Theme
Beginning of the Artistic Process	Preschool Primary School Secondary School University/Undergraduate Education
Reason for Orientation	Art Teacher Interest and Talent Influence of Relatives My desire to become a teacher
Outcomes	Improved drawing and design skills Changing perspective Planned, stable, maximum efficiency Knowledge, experience Meaningful and Useful Lessons

Artistic Development Process	Continuing Development Gaining discipline Field selection Successful process Creative thinking Self-development

The detailed responses from undergraduate art education students are as follows:

(S4) "*My painting journey began in secondary school.*"

(S8) "*I started by receiving education at the public education center in 2010.*"

(S9) "*I began with enthusiasm at the age of 5-6 when my sister was doing her painting homework at home.*"

Upon analyzing these responses, it was observed that most students identified the beginning of their artistic journeys as occurring prior to their undergraduate education.

In response to the question, "What motivated you to study in the Department of Painting?" undergraduate art education students mentioned influences such as an art teacher, personal interest and talent, encouragement from relatives, and a desire to become a teacher.

The detailed responses from undergraduate art education students are as follows:

(S6) "*I realised I was good in this field with the in-school course and exhibition held by my high school art teacher.*"

(S8) "*My primary school teacher thought that I had a wide imagination world and I entered this process when the pictures of each week were put up for voting and the pictures were hung on the class board.*"

(S10) "*When I realised that visual arts, my biggest hobby, is a field that complements and reflects me, my aim of reflecting it to my life, having received its education, led me to this field.*"

When the detailed responses given by the students were analysed, it was seen that the students were mostly directed to the field of art by their relatives, apart from their interest and talent in the field of art.

According to the data in Table 1, in response to the question, "What are the contributions of the courses you have taken in the field of art education?" undergraduate art education students reported that they had developed skills in drawing and design, gained new perspectives, improved planning and stability, achieved maximum efficiency, and acquired knowledge and experience through meaningful and useful lessons.

The detailed responses from undergraduate art education students are as follows:

(S2) "*I have gained a lot thanks to art. And I look around in a different way.*"

(S4) "*All the courses we take in this department are very meaningful and give us a lot.*"

(S10) "*It has provided numerous benefits in terms of developing my knowledge, experience and ability in many areas, whether theoretical or practical, in the field of visual arts and on the way to the teaching profession.*"

When the responses given by the students are analysed, it is seen that the courses taken in art education provide significant benefits to their development.

In response to the question, "If you evaluate yourself, what kind of artistic development have you shown since the 1st grade?" undergraduate art education students provided answers such as continuous development, gaining discipline, selecting a focus area, experiencing a successful process, fostering creative thinking, and achieving self-development.

The detailed responses from undergraduate art education students are as follows:

(S1) "*I liked the work I did in the 1st grade and I improved better every year.*"

(S2) "*I think I have improved myself in every field in 4 years.*"

(S6) "*I discovered that I was interested in the field of art history with the education I received throughout the university. Based on the styles we tried in the first and second grades, I discovered the field that appealed to me. And with the education I received, I decided which field I could develop in and which field I was more interested in.*"

When the detailed answers given by the students were analysed, it was seen that they had made significant improvements by the end of their undergraduate education.

Themes were identified based on the opinions of undergraduate painting and art education students regarding their artistic development processes. Analysis of the sub-themes revealed that students commonly began their artistic journeys in preschool, primary school, secondary school, university, or through public education centers. While students primarily credited their art teachers for inspiring their artistic orientation, some also mentioned family members, such as fathers and cousins, as influences. Additionally, students cited their own interests and talents as motivating factors in their pursuit of art. Many students expressed that their artistic process is ongoing, contributing to their sense of discipline. They also noted that the theoretical and practical courses they completed positively influenced their field selection and creative thinking skills. Most students reported beginning their artistic development in childhood, guided by teachers and family, and they acknowledged their own awareness of their interests and abilities. Overall, the students expressed satisfaction with their artistic development processes.

As shown in Table 2 below, when undergraduate art education students reviewed the portfolios prepared by their peers, their responses to the question, "Is the prepared portfolio adequate to explain your peer's development process?" included statements indicating that it was adequate, improvable, or inadequate.

How do undergraduate art education students evaluate their peers' artistic development processes?

Table 2. Peer evaluation of artistic development processes

Sub-theme	Code
Portfolio adequacy	Adequate Improvable Inadequate
Content adequacy	Successful Adequate Improvable Inadequate
Expression	Yes Partially
Artistic development process	Successful Advanced Planned Impressive Efficient Improvable

Peer evaluations regarding the portfolio adequacy of art education undergraduate students' portfolios include the following:

(S1) "*I believe it will be fully adequate as the process progresses.*"

(S3) "*I think they have deficiencies; they are inadequate .*"

(S10) "*Yes, it is adequate.*"

When the detailed answers given by the students were analysed, it was seen that most peers found the students' educational development files to be generally adequate.

In Table 2, when undergraduate art education students reviewed the portfolios prepared by their peers, their responses to the question, "What do you think about the works in the portfolio prepared by your peer?" included the categories: successful, adequate, improvable, and inadequate.

Peer evaluations regarding the content adequacy of art education undergraduate students' portfolios include the following:

(S3) "*I think it is incomplete and inadequate.*"

(S5) "*She reflected her development process in her portfolio with all the details.*"

(S9) "*He seems to have improved himself.*"

When the detailed answers given by the students were examined, it was seen that while they generally found the studies in their peers' portfolios to be successful, some also expressed that they found certain aspects inadequate.

In Table 2, when art education undergraduate students reviewed the portfolios prepared by their peers, their responses to the question, "Was your peer who presented the portfolio able to express their artistic process?" were either "yes" or "partially."

Peer evaluations regarding the artistic expression of art education undergraduate students' portfolios include the following:

(S1) "Partially able to express."

(S3) "*Yes, he could.*"

(S6) "*Yes, he expressed his process with all his works.*"

When the detailed answers given by the students were analysed, it was seen that most students observed their peers were generally able to express themselves effectively.

In Table 2, when art education undergraduate students reviewed the portfolios prepared by their peers, their responses to the question, "How do you think your peer's artistic development process is?" included descriptors such as successful, advanced, planned, impressive, efficient, and improvable.

Peer evaluations regarding the artistic development processes of undergraduate art education students are as follows:

(S4) "*When I look from the beginning to the end, it has shown positive development.*"

(S6) "*He had a very productive process.*"

(S10) "*A successful process was followed within a certain plan and programme.*"

When we look at the detailed answers given by the students, it was seen that students generally used positive language and appreciated their peers' development processes eers.

In the sub-themes related to the theme of portfolio adequacy in peer evaluations of the artistic development processes of art education undergraduate students, most students indicated that their peers' portfolios were adequate. However, some noted that certain portfolios had potential for improvement. Within the sub-themes related to the quality of the work, students generally found their peers' work to be quite successful and considered the portfolios adequate. Some students, however, identified areas for improvement and regarded certain portfolios as inadequate. In peer feedback on the theme of expression, the majority of students responded affirmatively, indicating that their peers were able to express their artistic processes clearly. A few students, however, felt that their peers only partially conveyed their artistic development. Regarding the theme of the artistic development process itself, students often described their peers' progress as successful, noting that they demonstrated growth and followed a structured approach. While many students found their peers' development processes impressive and efficient, some suggested that further improvements could be made. Overall, it can be said that the students were objective in their evaluations, often using similar expressions to describe their peers' artistic development.

The experts who examined the portfolios of the undergraduate art education students answered the question, "Is the prepared portfolio adequate to explain the development process?" as adequate, improvable, or inadequate (Table 3).

How do experts evaluate the artistic development processes of undergraduate art education students?

Table 3. Expert evaluation of artistic development processes

Sub Theme	Code
Portfolio Adequacy	Adequate
	Can be improved
	Inadequate

Content Adequacy	Successful Adequate Can be improved Inadequate
Expression	Yes Partially No.
Recommendations	Ensure careful attention to spelling accuracy. Include an imprint for each study. Provide additional work samples for a comprehensive overview. Focus on enhancing the design quality. Present content in chronological order. Classify studies systematically. Illustrate images with detailed precision. Attach a resume, including a photograph.

Expert evaluations regarding the portfolio adequacy of art education undergraduate students' portfolios include the following:

(E1) "*It is adequate; you can see the process of each study*."

(E3) "*The portfolio prepared by the student is adequate to explain the development process*."

(E4) "*The portfolio prepared is adequate for the last periods of the development process, but it gives insufficient information about the development process of the first period studies*."

When the detailed answers given by the experts were analysed, it was seen that the students' portfolios were mostly improvable.

The experts who analysed the portfolios of undergraduate art education students answered the question, "What do you think about the works in the portfolio?" as successful, sufficient, improvable, and insufficient.

Expert evaluations regarding the content adequacy of art education undergraduate students' portfolios include the following:

(E1) "*The works exemplify the art works that the student experiences during the learning process.*"

(E3) "*The works in the portfolio show that the student progresses in a disciplined and conscious manner within the art education process.*"

(E5) "*The technique of many studies was explained, but why he did it was not mentioned much, which is not a big deficiency, but it would have been good to explain. I observed the development from the first study to the last study in a positive way.*"

When the detailed answers given by the experts were analysed, it was seen that the experts found the content of the students' portfolios mostly improvable.

The experts who analysed the portfolios of the undergraduate art education students answered the question, "How is the artistic development process of the student?" as yes, partially, and no.

Expert evaluations regarding the artistic expression of art education undergraduate students' portfolios include the following:

(E2) "The *student has improved during the process.*"

(E4) "*I think that the art education she received for three years could not adequately reflect the art education she received for three years to her recent original works. The reason for this is that the training was carried out remotely during the earthquake process. His artistic development is sufficient in the processes in which he received face-to-face education.*"

(E5) "*His patterns are very good, which shows that he is also successful in other techniques. If we had seen more work, we could have seen better development, but in general, he is successful.*"

When the detailed answers given by the experts were analysed, they were mostly able to express the artistic development processes of the students.

As shown in Table 3, experts who reviewed the portfolios of undergraduate art education students provided the following recommendations for portfolio preparation: *ensure careful attention to spelling accuracy; include an imprint for each study; provide additional work samples for a comprehensive overview; focus on enhancing the design quality; present content in chronological order; classify studies systematically; illustrate images with detailed precision; and attach a resume, including a photograph*.

Expert evaluations regarding recommendations for the portfolio preparation processes of undergraduate art education students are as follows:

(E1) "*The studies should be classified chronologically, the studies should be classified by field, and there should be too many studies related to a field of study. 1 study cannot exemplify the graphic course. In addition, visuals should be detailed and given with photographs. The studies should have an imprint, and there should be a photographic CV on the first page.*"

(E2) "*The name, year, and description of the study can be under the studies.*"

(E4) "*As a suggestion, the portfolio can be prepared within a design. Portfolios can include more work samples.*"

According to the experts' detailed responses, they provided supportive and guiding suggestions for improving student portfolios.

Analysis of expert opinions on the artistic development processes of art education undergraduate students revealed that experts considered the portfolios to be sufficient, developable, or insufficient. Experts also rated the students' artistic development files as successful, adequate, developable, or insufficient. In terms of students' ability to express their artistic development, responses were categorized as yes, partially, or no. Experts recommended that students' artistic development files should pay attention to spelling accuracy, include the imprint of each work, and provide more examples of work. Additional suggestions included careful attention to portfolio design, establishing a chronological order, and organizing works into classifications. Experts further advised that visuals be photographed in detail and that a CV with photographs be included in the portfolio.

According to the data in Table 4, when the a/r/tographic inquiry processes of undergraduate art education students are examined, it is seen that there are expressions about achievement and satisfaction, development and progress, perseverance and fulfillment, awareness and insight, fatigue.

How did the a/r/tographic inquiry processes progress for undergraduate art education students?

Table 4. A/r/tographic inquiry processes of undergraduate art education students

Theme	Sub Theme
A/r/tographic Process	Achievement and satisfaction Development and progress Perseverance and fulfillment Awareness and insight Fatigue
Research Process	Struggle Self-reflection and questioning Persistence and dedication Implicit growth
Education Process	Comprehensive Versatile Detailed Intensive Coincidental Determined
Artistic Process	Infinite/continuous Expressive Creative Patient Emotionally intense/dynamic Self-confident Determined

The views of undergraduate art education students on the a/r/tographic process are as follows:

(S7) "*After high school, I took a long break from painting. In 2019, I decided to continue and prepared for the university exam. At this stage, I achieved the required score, took the university talent exams, and was accepted.*"

(S8) "*After high school, I initially studied the department my family wanted. When I couldn't secure a position for two years after graduation, I convinced my family—though it was challenging—and began a course. My course education lasted about six months, and I was finally accepted into the department I wanted.*"

(S10) "*I improve my knowledge in the field of visual arts by gaining new experiences every day.*"

When the detailed answers given by the students were analysed, it was seen that most of them expressed a sense of success regarding the a/r/tographic process.

According to the data in Table 4, undergraduate art education students defined the research process as struggle, self-reflection and questioning, persistence and dedication, implicit growth.

The views of undergraduate art education students on the research process are as follows:

(S1) "*I studied in the department of Child Development in high school. I took the aptitude test in various cities and decided to study at the Faculty of Education in Erzincan.*"

(S3) "*I am currently preparing for the KPSS, and once I am appointed according to my goals, I want to take an exam like ALES and pursue a master's degree.*"

(S9) "*Although I found interior architecture appealing, I developed an interest in teaching painting during my last years of high school. Despite several attempts by my family to steer me towards other professions, I eventually convinced them.*"

When the detailed answers given by the students were analysed, it was seen that most students demonstrated determination throughout their research process.

As the data in Table 4 showed, undergraduate art education students defined the educational process as comprehensive, multifaceted/versatile, detailed, intensive, coincidental, and determined.

The views of undergraduate art education students on the education process are as follows:

(S1) "*My artistic journey began two years after high school. As I had no interest or aptitude in subjects like mathematics and science, I never considered those fields.*"

(S5) "*Over four years, I took courses in Pattern, Basic Design, Perspective, Graphic Design, Sculpture, Industrial Design, and Printing. I gained a solid understanding of techniques and applications from both Fine Arts High School and university courses.*"

(S6) "*During my undergraduate studies, I took various practical and theoretical courses, including basic design, workshop courses, graphics, photography, original printing, and traditional Turkish arts.*"

When the detailed answers given by the students are analysed, it is seen that there are students who stated that some students were guided toward the educational process by chance, while others approached it with clear determination and intentionality.

According to the data in Table 4, art education undergraduate students stated that they were infinite/continuous, expressive, creative, patient, emotionally intense/dynamic, self-confident and determined about their artistic processes.

The views of undergraduate art education students on the artistic process are as follows:

(S4) "*I can say that the education I received in art taught me patience above all.*"

(S5) "*My formal art education may come to an end, but life is a school, and our learning in this school will never end.*"

(S9) "*We all express our accumulated struggles and frustrations through art, almost as if we are screaming. I believe this is beautifully conveyed through art.*

When the detailed answers given by the students are analysed, it is seen that they are able to effectively express their artistic processes.

Themes were identified regarding the a/r/tographic inquiry processes of undergraduate art education students. Examination of the sub-themes revealed that students' a/r/tographic processes were marked by success, satisfaction, progress, perseverance, and determination. Some students mentioned experiencing struggles in the research process, while others noted that the process unfolded with intention and purpose. While many students engaged with the process actively and reflectively, some described their approach to the research process as somewhat unconscious. Students characterized their educational experience as comprehensive, though they felt the course content was dense. Some students noted that their involvement in the process occurred by chance, while others pursued their education with a decisive approach. In discussing their artistic journeys, students used terms such as endless, expressive, innovative, and patient, though some described their processes as unsteady or determined. Additionally, a number of students expressed their artistic development with a sense of self-confidence.

How are the artistic products created by undergraduate students of art-work education (SoAE: Student of Art-Work Education) at the end of the artographic inquiry process?

Some of the original products created by the workshop students at the end of the artographic inquiry process are as follows.

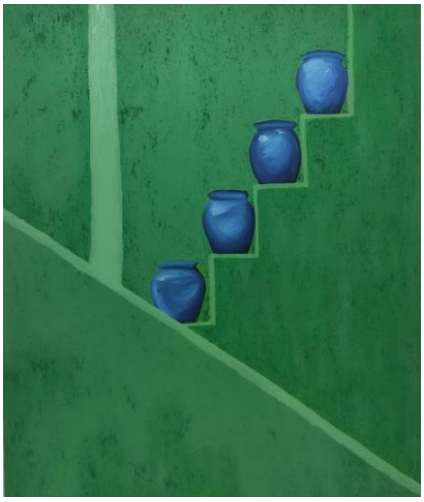
SoAE2

The process of SoAE2 is as follows:

"In my original work, I incorporated elements such as figures, light, and shadows to reflect all the knowledge I gained during my artistic development process. I will continue to develop my art at the university where I graduated, and the appreciation of my original work has been very supportive of my motivation."

SoAE2 noted that they expressed the knowledge acquired in their work through an original style rather than a realist one.

SoAE3



The process of SoAE3 is as follows:

"My interest in art, which started in my childhood years, started with the guidance of my technology design teacher... I wanted to use the wall effect in this work, which I designed by preparing many sketches, and I made a 100x120 vase work with sand grains and acrylic paint technique. I felt more free while doing this work, so I can say that sand grains inspired me."

Regarding his artistic process, SoAE3 stated that he used sand grains for the wall texture in his original work that he created by preparing sketches and that he was satisfied with his work that he prepared with a free style.

SoAE4

The process of SoAE4 is as follows:

"I have loved painting for as long as I can remember...My original work was created by combining the works of an artist in a balanced way. Since I love flowers and nature very much, I combined two paintings by Van Gogh. I think I created a beautiful work."

SoAE4 stated that he liked painting very much and wanted to reflect his artistic identity in his original work.

SoAE5

The process of SoAE5 is as follows:

"In my last workshop, I created by adopting the philosophy of Minimalism...In this work, simplicity is at the forefront and the sanctity of nature is represented by using the predominant green colour. Of course, I added a piece of myself, the Avocado Still Life hanging on the wall. It is the first acrylic work I worked on during my undergraduate period. It is a special detail for me."

SoAE5 said that in his original work, which he created with the philosophy of minimalism, he included nature and still life inspirations and expressed them with special additions.

SoAE9

The process of SoAE9 is as follows:

"In the last work of my undergraduate education, I prepared a composition by paying attention to the element of balance with a photograph of me screaming with Edvard Much's screaming work. I think it is balanced and harmonious. We all have the expression of the troubles and depression accumulated in us by screaming. I think this is beautifully conveyed through art."

SoAE9, who stated that he made many works throughout his art education but that he gave meaning to the last original work that would reflect himself by adding something from himself, said that he was inspired by Munc's Scream painting.

An examination of the final artistic works of main art workshop students at the end of their undergraduate education revealed that they sought to incorporate the knowledge and experiences gained throughout their studies. In these final pieces, created without restrictions on subject or technique, students engaged in a/r/tographic inquiries to produce their works. Overall, students expressed satisfaction with their final projects, noting that these works authentically represented their inner worlds.

Conclusion and Discussion

This research aims to investigate the artistic development processes of art education undergraduate students through an a/r/tographic lens and to examine the role of portfolio preparation in this process. Findings related to the first sub-purpose reveal that students' artistic journeys began at various stages, including preschool, primary school, middle school, pre-service education, and community centers. While students were primarily influenced by art teachers, family members—such as fathers and cousins—also played a significant role. Additionally, students' interests and talents further motivated their engagement in the artistic process, which appears to be ongoing and developmental, fostering discipline. The theoretical and practical courses encountered during their art education were found to be instrumental in their field selection and in promoting creative thinking. Students expressed satisfaction with their artistic progress, though it was noted that the distance education process had some impact on their development. Bilir-Seyhan & Ocak-Karabay (2018) emphasize the importance of knowledgeable adults in children's aesthetic development, with teachers playing a particularly influential role. Supporting students' interest and attitudes toward art, Tufan & Güdek (2008) suggest that attitudes help individuals adapt to their environment and guide their behaviors accordingly. In alignment with students' positive reflections on their undergraduate education, Karip (2019) notes that students who receive an education grounded in skills, knowledge, attitudes, and values relevant to the teaching profession integrate more effectively into the educational system.

Analysis of findings related to another sub-objective of this research showed that students generally regarded their peers' works as successful and considered the portfolios adequate for representing artistic development processes. Some students, however, noted areas where their peers' portfolios could be improved and found certain aspects inadequate. Overall, students felt that their peers were able to express their artistic processes effectively within the portfolios and viewed the artistic development process as both successful and planned. While many students found their peers' artistic development processes impressive and efficient, others identified areas for further improvement. Students demonstrated objectivity in evaluating their peers, often using similar language. According to Weaver & Cotrell (1986), peer assessment promotes responsibility among students and motivates them in their work. Peer assessment is also viewed positively for creating a transparent framework, offering evaluation experience, enhancing focus on learning, and providing constructive feedback. Falchikov (1995) defines peer assessment as a technique in which individuals evaluate each other based on specified criteria. This method not only increases students' sense of responsibility and motivation but also enables them to take an active role in the learning process, offering valuable feedback within a structured evaluation framework.

Analysis of findings related to another sub-objective of this research revealed that experts considered the portfolios of undergraduate art education students to be generally adequate but noted areas for improvement. Expert evaluations rated the portfolios as sufficient, improvable, or insufficient in terms of portfolio adequacy. Experts also

assessed the students' ability to express their artistic development processes, with responses of "yes," "partially," and "no." Experts offered several recommendations for enhancing the portfolios: attention to spelling, inclusion of an imprint for each work, and additional work samples. They also advised improving portfolio design, organizing content chronologically, and classifying the studies. Regarding photographs in the portfolios, experts emphasized that visuals should be taken in detail, and a CV with photographs should be included. Başkale (2016) highlighted the importance of expert input in research, noting that having individuals with broad knowledge of the research topic and specialized in qualitative methods review the study from various perspectives is one way to enhance its credibility.

Analysis of findings related to another sub-objective of this research provides insight into the progression of a/r/tographic questioning processes among undergraduate art education students. Statements from students indicate that their a/r/tographic processes were marked by success, satisfaction, development, perseverance, and progress. Although some students experienced challenges in the research process, their progress continued with determination. While most students engaged consciously in the questioning process, a few described their approach as somewhat unconscious. It was also concluded that students viewed the educational process as comprehensive, though the course content was intensive. Some students felt they entered the process by chance, while others acted decisively in their educational journey. Students described their artistic processes with terms like infinite, expressive, innovative, and patient, though some noted their processes were uneven or defined by determination. Başyurt and Taşkesen (2022) conducted a study in which students, prior to their original workshops, engaged in questioning their a/r/tographic processes. They embraced the process with enthusiasm, ultimately producing meaningful artistic works. Similarly, Güneş (2018) observed that workshop students initially approached the process with uncertainty, but as they progressed with questioning, the process gained significance. Mavioğlu (2019), in his work on visual culture studies and the subconscious, found that recording the process through a/r/tography allowed it to progress efficiently through sustained inquiry. These studies on the a/r/tographic process provide valuable support to the current research findings.

Analysis of findings related to another sub-objective of this research reveals that students in the painting and art education workshop successfully integrated the a/r/tographic questioning process into their final artistic works. These original products, created at the end of their undergraduate studies, reflect the knowledge and experiences students gained throughout their education. Without limitations on subject or technique, students engaged in a/r/tographic inquiry to express their inner worlds, resulting in a general sense of satisfaction with their final works. Supporting studies illustrate the impact of the a/r/tographic approach. Ülüş (2017), for example, used photographs from infancy and adulthood to create meaningful products, while Dağlıoğlu (2021) highlighted the effectiveness of a/r/tography's non-linear structure in generating profound interpretations of processes through active inquiry. Similarly, Başar, Işır, and İnce (2019) explored self-perceptions through a/r/tographic inquiry, producing artistic outcomes

from their analyses. Keser & Narin (2017) also emphasized that a/r/tography allows individuals to explore phenomena by embracing the roles of artist (a), researcher (r), and teacher (t), though they noted some limitations of the method. These existing studies support the current findings, reinforcing the value of a/r/tography while also acknowledging certain limitations.

An examination of students' artistic development processes revealed that this journey typically begins in childhood, often influenced by art teachers and family members. Additionally, students' personal interests and talents play a key role in their orientation toward art. It was observed that students continued to develop artistically, gaining discipline and benefiting from the theoretical and practical courses they completed. Peer evaluations indicated that students' portfolios were generally adequate, though with room for improvement. Expert evaluations similarly rated the students' artistic development files as successful, sufficient, and improvable. Experts recommended addressing spelling errors, including additional work samples, emphasizing design, and taking detailed photographs. In analyzing the a/r/tographic inquiry process, it was found that students progressed with success and satisfaction, overcoming challenges along the way. However, some students described their engagement as unconscious or accidental. Overall, students expressed their artistic journeys with positive and self-confident language.

Recommendations

Based on the results of this research, recognizing and further developing the a/r/tography method is of considerable importance. This method allows undergraduate art education students to identify themselves in the roles of researcher, teacher, and artist, fostering inquiry and adding depth and meaning to their work.

Additionally, applying the portfolio assessment method across all areas of art education enables students to recognize their artistic contributions, critically reflect on their progress, and build awareness of their developing skills. It is therefore recommended that the portfolio assessment method be widely adopted in art education.

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Genişletilmiş Türkçe Özet

Eğitim, bireyin yaşamında istenilen yönde davranış değişikliği kazanmasını amaçlayan bir süreçtir. Senemoğlu (2002), eğitimi insan sermayesine yatırım, kişilik gelişimi ve istendik davranış oluşturma veya değiştirme süreci olarak tanımlamıştır. Bu süreçte birey birçok alanda gelişip davranış kazanabilir. Bu süreçten, sanat eğitimi de etkilenerek gelişip ve değişmektedir. Küçüktepepınar (2014)'e göre sanat eğitimi, bireyin duygu, düşünce ve izlenimlerini ifade etmesini ve yeteneklerini estetik bir seviyeye taşımasını amaçlayan eğitim faaliyetlerinin bütünüdür. Sanatsal gelişim süreçlerinde ortaya çıkan ürünlerin, kişinin kendi gelişim sürecini takip etmesinde önemli bir rol oynadığı bilinmektedir. Sanatsal ürünlerin kalıcılığı, bilgi ve becerilerin toplu olarak sunulmasını gerektirir; bu nedenle tüm çalışmaların saklanması önemlidir. Sanatsal gelişim sürecinin takibinde eğitsel gelişim dosyalarının (portfolyo) hazırlanması büyük önem taşır. *"Belirli bir süredeki öğrenmelerin hem süreç hem de ürün yönünden gözlenmesi amacıyla öğrencinin yaptığı tüm çalışmaları kapsayan bir dosyadan bahsediliyorsa, bunun için en uygun sözcüğün "gelişim dosyası" olduğu söylenebilir"* (Alıcı, 2008, s.137). Bu süreçte, öğrencinin bir veya daha fazla yeteneğindeki gelişimi veya akademik başarısını önceden belirlenen öğretim hedeflerine ulaşabilme yolları ve kazanımlarının planlı ve sistematik olarak incelenmesi temel alınmaktadır. Ancak bu değerlendirme yaklaşımının sınırılıkları bulunmaktadır. *"Değerlendirme yaklaşımı tek başına alındığında sanatsal çalışmanın gelişimi ve öğrencinin düşünme süreçleri hakkında bilgi toplama bakımından sınırlıdır"* (Hurwitz & Day, 1995, s.87). Sanat temelli yaklaşımlar, sanat eğitiminde yeni ufuklar açmaktadır. Sanat temelli yaklaşımlarda, öğrenci süreç boyunca aktif olmalıdır; a/r/tografik sorgulama bu yaklaşımlardan biridir. A/r/tografi yönteminin uygulanması, çalışmanın problemi tanımlamasında ve alandaki farklı yöntemlerin örneklendirilmesinde önemlidir. Bu yöntem, öğrencilerin portfolyo hazırlama süreçlerinde sanatsal katkılarını fark etmelerini ve eleştirel bakış açısıyla gelişimlerini değerlendirmelerini sağlar, böylece sanatsal becerilerinin gelişimi konusunda farkındalık kazanmalarına olanak tanır.

Bu çalışmada resim-iş öğretmenliği lisans öğrencilerinin sanatsal gelişim süreçlerinin a/r/tografik olarak sorgulanması ve portfolyo hazırlamanın bu süreçteki rolünü belirlemek amaçlanmaktadır. Bu amaçla aşağıdaki alt amaçlara cevap aranmıştır.

1. Resim-iş eğitimi lisans öğrencilerinin kendi sanatsal gelişim süreçleri hakkında görüşleri nelerdir?

2. Resim-iş eğitimi lisans öğrencilerinin sanatsal gelişim süreçleri hakkında akran değerlendirmeleri nasıldır?

3. Resim-iş eğitimi lisans öğrencilerinin sanatsal gelişim süreçleri hakkında uzman değerlendirmeleri nasıldır?

4. Resim-iş eğitimi lisans öğrencilerinin a/r/tografik sorgulama süreçleri nasıl ilerlemiştir?

5. Resim-iş eğitimi lisans öğrencilerinin artografik sorgulama sürecinin sonunda oluşturdukları sanatsal ürünleri nasıldır?

Çalışmada nitel araştırma yöntemlerinden durum çalışması kullanılmış olup çalışmaya uygunluğu bakımından sanat temelli ve uygulama tabanlı araştırmalardan a/r/tografik sorgulama ile temellendirilmiştir. Sanat temelli a/r/tografi, araştırmacıya farklı kimlikler sunarak yaratıcı bir sorgulama süreci sağlar. A/r/tografik sorgulama sürecinde araştırmacı, eğitimci ve sanatçı kimlikleri öne çıkar.

Araştırma Resim-İş eğitimi anabilim dalı 4. Sınıf öğrencilerinin atölye dersinde yürütülmüştür. Çalışma grubu 10 gönüllü öğrenciden oluşmaktadır. Araştırmanın örneklemi ölçüt (amaçlı) örneklem yolu ile seçilmiştir. Araştırmanın çalışma grubu seçilirken öğrencilerin alt atölye süreçlerini tamamladıkları dönem tercih edilmiştir. Araştırmanın verileri, öğrenci eğitsel gelişim dosyaları (portfolyo), yarı yapılandırılmış görüşme formu, a/r/tograf görüşleri, akran görüşleri, uzman görüşleri ve süreç sonunda ortaya çıkan sanatsal ürünlerden oluşmaktadır. Sanat temelli bir araştırma yöntemi olan a/r/tografik sürece ilişkin verilerin analizinde nitel veri analizi kullanılmıştır. Buna göre eğitsel gelişim dosyalarının(portfolyo) öğrenci, akran ve uzman değerlendirmelerinde içerik analizi kullanılmıştır. Öğrencilerin sanatsal süreçleri ve a/r/tografik sorgulama süreçleri betimsel analiz kullanılarak çözümlenmiştir.

Resim-iş eğitimi lisans öğrencilerinin sanatsal gelişim süreçleri hakkında görüşleri incelendiğinde, sanatsal gelişim süreçlerine çoğunlukla çocukluk dönemlerinde başlamış olup resim öğretmenleri ve aile üyeleri tarafından yönlendirildiklerini söylemiş, ayrıca ilgi ve yeteneklerinin farkında olduklarına ifadelerinde yer vermişlerdir. Öğrencilerin sanatsal gelişim süreçlerinden memnun oldukları da ifadelerinden anlaşılmaktadır.

Resim-iş eğitimi lisans öğrencilerinin sanatsal gelişim süreçleri hakkında akran görüşlerinde çoğunlukla portfolyolarının yeterli olduğunu ifade etmişlerdir. Öğrenciler, akranlarını başarılı bulmuş ve portfolyonun yeterli olduğunu ifade etmişlerdir. Bazı öğrenciler, akranlarının portfolyolarını incelediklerinde çalışmalarını yetersiz ve geliştirilebilir bulmuşlardır. Öğrencilerin çoğunluğunun akranlarının sanatsal sürecini ifade edebildiğini söyleyerek evet cevabını vermişlerdir. Öğrenciler akranlarının sanatsal gelişim sürecini başarılı bulurken, akranlarının süreç içinde gelişmiş olduğundan, planlı ilerlediğinden bahsetmişlerdir. Öğrencilerin akranlarının sanatsal gelişim sürecini etkileyici ve verimli bulduğu ifadelerinde yer alırken bazı öğrenciler geliştirilebilir olduğunu ifade etmiştir. Öğrencilerin akranlarını değerlendirirken oldukça objektif davrandıkları ve benzer ifadeler kullandıkları söylenebilir.

Resim-iş eğitimi lisans öğrencilerinin sanatsal gelişim süreçleri hakkında uzman görüşleri incelendiğinde; uzmanlar, portfolyoların yeterli, geliştirilebilir ve yetersiz olduğunu ifade etmişlerdir. Öğrencilerin sanatsal gelişim dosyaları da başarılı, yeterli, geliştirilebilir ve yetersiz bulunmuştur. Öğrencilerin sanatsal gelişim süreçleri kendilerini ifade edebilme düzeylerini evet, kısmen ve hayır şeklinde yanıtlar verilmiştir. Alan uzmanları,

öğrencilerin sanatsal gelişim dosyaları için yazım hatalarına dikkat edilmesi gerektiğinden, portfolyo da çalışmaların künyesine yer verilmesi gerektiğinden bahsederek, portfolyolarda daha fazla çalışma örnekleri bulunması gerektiğini önermişlerdir. Uzmanlar portfolyolar için tasarıma dikkat edilmeli, kronolojik sıralamaya yer verilmeli, çalışmalar tasniflenmeli şeklinde önerilerde bulunmuşlardır. Ayrıca portfolyolardaki fotoğraflar ile ilgili uzmanlar görseller detayları ile fotoğraflanmalı ve portfolyoda fotoğraflı özgeçmişe yer verilmeli şeklinde ifadeler kullanmışlardır.

Resim-iş eğitimi lisans öğrencileri a/r/tografik süreçlerinin başarı ve memnuniyet ile sürdüğünü, gelişim ve ilerleme kaydettiklerini ifade etmişlerdir. Öğrencilerin araştırma sürecinde genellikle mücadeleci oldukları ve kararlı bir şekilde ilerledikleri ifadelerinde yer almaktadır. Öğrenciler eğitim süreçlerinin kapsamlı geçtiğini söylerken aynı zamanda derslerin içeriklerinin yüklü olduğuna ifadelerinde yer vermişlerdir. Öğrenciler sanatsal süreçlerini sonsuz, dışavurum, yenilik ve sabır şeklinde ifade ederken bazı öğrenciler sanatsal süreçlerinin inişli çıkışlı olduğunu veya kararlı ve özgüvenli olduklarını ifade etmişlerdir.

Ana sanat atölye öğrencilerinin lisans eğitimleri sonunda çıkardıkları sanatsal ürünlerinde, aldıkları lisans eğitimi boyunca öğrendikleri bilgi ve deneyimleri eserlerine yansıtmaya çalıştıkları görülmüştür. Öğrenciler a/r/tografik sorgulamalar yaparak, iç dünyalarının dışa vurumu olarak yansıttıkları son çalışmalarından genellikle memnun olduklarını ifade etmişlerdir.

Öğrencilerin sanatsal gelişim süreçlerinin genellikle çocukluk dönemlerinde başladığı ve resim öğretmenleri ile aile üyelerinin etkisiyle yönlendirildiği, öğrencilerin ilgi ve yeteneklerinin de sanata yönelmelerinde önemli bir rol oynadığı görülmüştür. Öğrencilerin, sanatsal süreçlerinin gelişerek devam ettiği, disiplin kazandıkları ve aldıkları teorik ve uygulamalı dersler ile başarılı bir süreç geçirdikleri görülmüştür. Akran görüşlerinde portfolyolarının genellikle yeterli bulunduğu ancak geliştirilebilecek potansiyelde olduğu tespit edilmiştir. Uzman görüşlerine göre, öğrencilerin sanatsal gelişim dosyaları genellikle başarılı, yeterli ve geliştirilebilir bulunmuştur. Öneriler arasında, portfolyoların yazım hatalarına dikkat edilmesi, daha fazla çalışma örneği eklenmesi, tasarımın önemine vurgu yapılması ve fotoğrafların detaylı çekilmesi gibi konular yer almaktadır. A/r/tografik sorgulama süreçleri üzerine yapılan incelemede, öğrencilerin sürecin başarı ve memnuniyetle sürdürdüğü, mücadele ettikleri ve gelişim kaydettikleri belirlenmiştir. Öğrencilerin sanatsal süreçlerini ifade ederken genellikle olumlu ve özgüvenli oldukları görülmüştür.

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Integration of Micro-Credentials into Higher Education: Faculty Perspectives

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Abstract: The aim of this study is to examine the views and expectations of instructors regarding micro-competencies, which are believed to have a significant impact on the future of learning and teaching in higher education. In the study, which took a phenomenological approach based on qualitative research methods, interviews were performed with 12 faculty chosen using a criterion sample procedure and semi-structured interview forms. The collected data was evaluated using both content and descriptive analysis. As a result of the investigation, 2 main themes and 12 sub-themes emerged. As a result of the research, it was determined that micro-competencies have not been sufficiently conceptualized in higher education; micro-competencies are similar to various structures inside and outside the university; different models for their structuring are proposed; and potential problems are anticipated, as well as facilitating options for their implementation. Although it is known that policy and preparation studies are being carried out in the relevant institutions, it is hoped that the views of the faculties revealed as a result of the research will shed light on the integration of micro-competencies into higher education in a more qualified way.

Keywords: Micro-credit, extra-curricular competences, recognition of prior learning, European Qualifications Framework, Council of Higher Education.

About the Article

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Introduction

Micro-Credentials, which have gained significant importance in recent years, are short and focused credits designed to provide the demanded knowledge, skills, and experience. Aggregated micro-credentials can also provide a pathway to a certificate or degree. Micro-credentials are among the technologies and practices that will significantly impact the future of learning and teaching in higher education (Pelletier et al., 2023). The primary reasons for the growing interest in micro-credentials in higher education include the need to develop new competencies with the pandemic, employers' concerns about graduates' skill and competence levels, and challenges related to access to education (McGreal, Mackintosh, Cox, & Olcott, 2022). Micro-credentials are emphasized to be effective in acquiring new and emerging competencies, providing educational opportunities to disadvantaged and vulnerable groups, and ensuring lifelong learning by supporting personal development due to their characteristics of being competency-based, flexible, and demand-oriented (European Commission, 2020).

Despite the growing interest in micro-credentials and efforts to develop them among universities, the integration of micro-credentials into higher education is still in its early stages. One of the main factors hindering this integration is the low awareness of micro-credentials among stakeholders. Therefore, it is crucial to enhance the perspectives and awareness of critical stakeholders in higher education regarding micro-credentials. This study aims to examine the views and expectations of faculty members, who are key stakeholders in higher education, concerning micro-credentials. The next section presents a conceptual explanation of micro-credentials and the current state of their implementation in higher education.

What is a Micro-Credential?

Due to various approaches and practices adopted internationally, micro-credentials have been defined and labeled differently across countries and providers (Resei, Friedl, Staubitz, & Rohloff, 2019). For example, terms like digital credential, alternative credential, digital badge, micro-degree, and nanodegree are often used synonymously with micro-credentials. Micro-credentials encompass a range of formats, from brief courses to more extended diploma or degree programs. Some are designed to facilitate the acquisition of knowledge and understanding. This diversity has made the landscape of micro-credentials complex and fragmented (Cedefop, 2022; Oliver, 2021). Consequently, there has been a need for efforts to promote a common understanding of micro-credentials and raise awareness of their use. In line with this, a UNESCO report examined existing definitions and practices of micro-credentials, gathering input from 47 experts representing diverse regions and educational sectors. As a provisional consensus definition, the following was proposed: A micro-credential is: a) A record of focused learning achievement that verifies what the learner knows, understands, or can do. b) It includes assessments based on clearly defined standards and is issued by a credible provider. c) It holds standalone value and can contribute to or complement

other micro- or macro-credentials, including through recognition of prior learning. d) It meets standards required by relevant quality assurance (Oliver, 2022).

Similarly, a report published in 2022 by five educational institutions in Canada (Bigelow et al., 2022) outlined five key characteristics of micro-credentials:

1. Micro-credentials are related to a specific or distinct skill or competency.
2. Micro-credentials are awarded based on an assessment.
3. Micro-credentials are linked to employment or employers.
4. Micro-credentials can form part of formal qualifications or be added to them. They can be accumulated and incorporated into individual learning experiences.
5. Micro-credentials are short-term courses. They focus on learning within a limited time frame and typically on a specific area. Considering their size and scope, they are more flexible than traditional qualifications.

The different definitions in the literature were compared in light of these characteristics, and it was found that most definitions generally included the first two characteristics but lacked a definition encompassing all the characteristics. In our country, a nationally accepted definition of the micro-credential concept has yet to be established. However, creating a standard definition of the concept appears crucial to raising awareness about the use of micro-credentials.

Micro-Credentials in Higher Education

Universities must swiftly respond to the needs and expectations of industry and society, providing opportunities to empower their stakeholders with innovative skills. The acquisition of micro-credentials enables students to develop the skills that are requisite for their prospective careers. Additionally, micro-credentials can be used as a tool to provide educators with personalized, accessible, and competency-based professional development. It is emphasized that micro-credentials can strengthen the role of higher education institutions in lifelong learning by offering more flexible and modular learning opportunities and providing more inclusive learning pathways (EU, 2020). In a recent Horizon report, panelists assessed micro-credentials' potential to enhance equity, inclusion, and learning outcomes in higher education, without demanding extensive new literacy skills. They also noted that learners and educators would not struggle to adopt micro-credentials, institutional financial support would not be substantial, and the risk of failure would be low (Pelletier et al., 2023).

Despite growing global interest and efforts, the integration of micro-credentials in higher education remains in its early stages. The main barriers to the integration of micro-credentials in higher education are expressed as follows: the lack of policies and regulations regarding the design, implementation, and recognition of micro-credentials, stakeholders' low awareness of micro-credentials, insufficient technical infrastructure,

and the lack of digital competencies among faculty members (Clausen, 2022; Stefaniak & Carey, 2019). Recent international research involving university and industry leaders reveals a lack of agreed-upon standards and quality assurance concerning micro-credentials, which has prevented their widespread acceptance (Holon IQ, 2021). For instance, in 2020, the European Commission identified a distinction between two types of micro-credentials. The first type is offered by formal education institutions and aligns with the European Qualifications Framework and other credit systems. Standards for these micro-credentials can be easily established and integrated into the existing higher education process. On the other hand, the quality assurance management for the second category of micro-credentials, provided by non-formal education providers, is still unclear (EU, 2020). Moreover, Romero-Llop, Castro-Jiménez, Fitó-Beltran, Valero-García, and Martín-Aragón (2022) suggest that faculties and departments are reluctant to recognize credits earned elsewhere. The view is held by some that only higher education institutions should be responsible for the awarding and validation of accreditations. This perspective assumes that faculty members are best placed to guarantee consistency, ranking, and hierarchy within disciplines when designing micro-credentials. However, as academia is slow to adopt and implement micro-credentials, organizations are turning to micro-credentials offered by MOOC platforms to address their employees' skill gaps. Yet, the creation of micro-credentials should focus on collaborative efforts between academia and other institutions and organizations (Msweli, Twinomurinzi & Ismail, 2022).

At this point, the successful integration of micro-credentials into an institution's vision requires higher education leaders to clearly convey the importance and value of micro-credentials to all key stakeholders and to present convincing plans regarding their potential (Olcott, 2021). A review study on the use of micro-credentials in higher education found that there are almost no studies on the awareness of various stakeholders at the higher education level regarding micro-credentials (Thi Ngoc Ha, Spittle, Watt & Van Dyke, 2022). Ralston (2021) also noted that discussions about micro-credentials have largely been conducted at a high level (policymakers, higher education administration, employers, etc.), while the voices of those at lower levels (faculty members, students, etc.) have not been sufficiently heard. However, the low awareness of micro-credentials among students and faculty members significantly limits the potential of micro-credentials. From the perspective of faculty members, discussions about micro-credentials leading to significant changes in the structure of higher education may cause concern about their roles and positions within the university. Additionally, faculty members may be reluctant to make radical changes in teaching processes and, in this context, may not adopt micro-credentials (Murgatroyd, 2022). Therefore, it is crucial to understand the perspectives of key stakeholders on micro-credentials and to increase their awareness.

The aim of this study is to examine the views and expectations of faculty members regarding micro-credentials, which are believed to have a significant impact on the future of teaching and learning in higher education.

Method

Research Design

Since the aim of this research is to determine the views and expectations of faculty members working in higher education regarding the use of micro-credentials, a phenomenological approach, one of the qualitative research methods, has been followed (Creswell, 2017).

Participants

The participants of the study were selected using the criterion sampling technique of purposive sampling (Creswell, 2005). In this context, interviews were conducted with 12 faculty members who participated in the "Micro-credential Workshop" organized by the Vocational Qualifications Authority in Ankara during the fall semester of the 2023-2024 academic year. The participants invited to this workshop are key faculty members working on the institutional integration of micro-credentials at their respective universities. Demographic information about the participants is presented in Table 1.

Table 1. *Demographic information of the participants*

Participants	Title	Faculty /Institute	Department
P1	Associate Professor	Faculty of Science	Department of Molecular Biology and Genetics
P2	Professor	Faculty of Art and Design	Department of Fashion Design
P3	Lecturer	School of Foreign Languages	Modern Languages Unit
P4	Lecturer	Rectorate	
P5	Professor	Faculty of Engineering	Department of Bioengineering
P6	Associate Professor	Faculty of Education	Department of Mathematics and Science Education
P7	Associate Professor	Graduate School of Education	Program Development
P8	Associate Professor	Faculty of Physiotherapy and Rehabilitation	Physiotherapy and Rehabilitation Education and Communication
P9	Associate Professor	Faculty of Fine Arts	Interior Architecture
P10	Assistant Professor	Faculty of Engineering and Natural Sciences	Department of Geomatics Engineering
P11	Professor	Faculty of Pharmacy	Basic Pharmaceutical Sciences
P12	Professor	Faculty of Pharmacy	Pharmaceutical Professional Sciences

Table 1 shows that four participants hold the title of professor, five hold the title of associate professor, one is a doctor of faculty member, and two are instructors. Additionally, it can be noted that the participants are distributed across the fields of health, science-engineering, and social-humanities based on the units they work in.

Data Collection and Analysis

In order to deeply examine the perceptions and experiences of faculty members regarding micro-credentials, a semi-structured interview form with open-ended questions, developed by the researchers, was utilized. During the preparation phase of the form, a preliminary draft of the interview questions was created by reviewing the literature. Feedback was obtained from three (3) field experts, and the questions were revised based on this feedback. The final interview form, consisting of eight (8) questions, was titled "Faculty Member Interview Form on the Use of Micro-Credentials in Higher Education," and its content validity was tested through expert opinions.

Interviews, each lasting approximately 30 minutes, were conducted via the Zoom platform. With participants' consent, the interviews were recorded. The recordings were transcribed by the researchers. Both content analysis and descriptive analysis methods were used in analyzing the data obtained from the interviews. Data were analyzed using an inductive approach in content analysis. Descriptive analysis was employed to present the narratives through direct quotations from participants (Creswell, 2017). As a result of the analysis, 2 main themes and 12 sub-themes were created. Each sub-theme was examined in terms of its kodes, and findings were presented in detail under the findings section, including frequencies and direct quotations.

Ethics, Validity, and Reliability

All participants were informed about the study before participation and gave their voluntary consent. The participants were informed that their identities would remain confidential throughout the research process and were provided with more detailed and accurate information. In order to ensure anonymity in the research, participants were assigned codes (P1-P12) to protect their identities. To ensure content/coverage validity, the literature was thoroughly reviewed, and the interview questions were carefully written to cover all fundamental topics related to micro-credentials.

Transferability, which indicates the extent to which the results of a study can be applied to other contexts or situations, is also an important aspect in qualitative research (Batdı, 2019). The essence of external validity is the generalization of findings from specific situations to other similar situations (Merriam, 2015). To ensure external validity, the research report should include comprehensive information about the participants and the context of the study (Christensen et al., 2015).

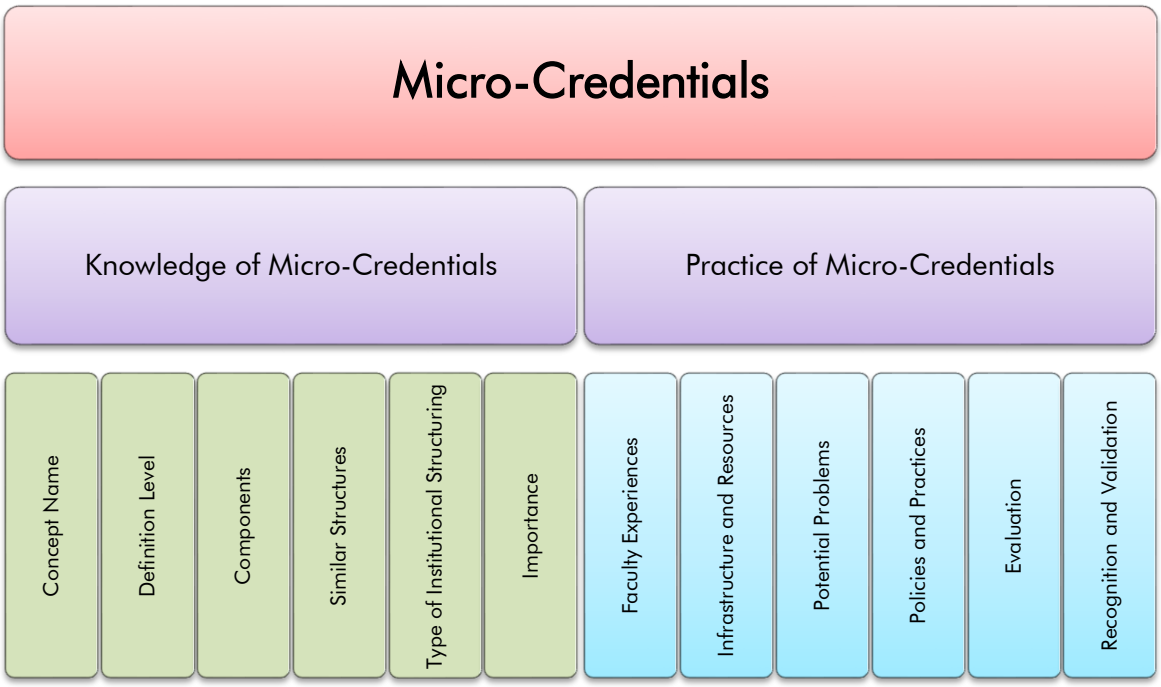
To ensure coding reliability, the data were coded by another researcher separately, and the codes were compared. The agreement percentage among experts regarding the coding of interview data was deemed sufficient for the reliability of data analysis (Yıldırım

& Şimşek, 2016). In case of disagreements, the researchers met to discuss the relevant codes and themes and reached a consensus with support from the literature. Additionally, to support the validity and reliability of the study, direct quotations from faculty members' views on codes and themes were presented in the findings.

Findings

This study aimed to deeply explore faculty members' views on micro-credentials. The data obtained from the interviews were thoroughly examined, and as a result of the analysis, participants' views on micro-credentials were categorized under the 2 main themes and 12 sub-themes presented in Figure 1.

Figure 1. *Themes*



Knowledge of Micro-Credentials

The codes related to the main themes and sub-themes presented in Figure 1 are sequentially provided in the findings. Firstly, participants' views on knowledge of micro-credentials are presented. The findings on how micro-credentials are conceptualised within the institutions are presented in Table 2.

Table 2. *Views on the Concept of Micro-Credentials*

Sub-theme 1 – Concept Name	f
1. Micro-Credit	5
2. Not Used/Absent	4
3. Micro-Credential	3

According to Table 2, five participants indicated that the term is used as micro-credit, and three participants stated it is used as micro-credential, while four participants revealed that the term is not used due to insufficient familiarity within their institutions.

Next, the participants' definitions of micro-credentials were examined. Three levels of definition were identified based on the extent to which participants defined the concept of micro-credentials. The findings are presented in Table 3.

Table 3. *Definition Levels of Micro-Credentials by Academic Staff*

Sub-theme 2 – Definition Level	f
1. Full: *Detailed and includes fundamental features of the concept.*	3
2. Mid-Level: *Similar to literature but includes some features of the concept.*	5
3. Weak: *Superficial definition.*	3

Note: One participant's response did not include a definition and therefore was not categorized.

According to Table 3, five participants provided a mid-level definition, three participants provided detailed and basic definitions, and one participant did not offer a definition of the concept. Examples of each definition level are provided below:

Detailed Definition:

> *"A micro-credential is a smaller skill that refers to a more specific skill than a macro-level competency or a larger skill, with characteristics such as being accumulative, transferable, and integratable, and it can be combined with a degree or macro-level qualification. It is a small skill earned either remotely or face-to-face." (P4).*

Mid-Level Definition:

> *"What I perceive as a micro-credential is, in essence, a unit not included in the normal curriculum, which could be from an institution, organization, or private sector. A credit is assigned based on the fulfillment of certain competencies, which is then incorporated into your own regulations." (P5)*

Superficial Definition:

> *"When I talk about micro-credentials, I mean bringing together entrepreneurship and the sectors where children can work. This is essentially our internal definition." (P1)*

The components emphasized by participants in their definitions of micro-credentials form another theme of the study. The obtained data are presented in Table 4.

Table 4. *Views on Micro-Credential Components*

Sub-theme 3 - Micro-Credential Components	f
1. Skill or Competency Focus	10
2. Connection with Traditional Programs	9
3. Assessment	6
4. Quality and Accreditation	6
5. Flexibility	4
6. Relevance to the Workplace and Employers	2
7. Short Duration	2
8. Digital Storage and Shareability	1
9. Personalized Instruction	1
10. Instructional Design Process/Improvement Potential	1

According to Table 4, the most frequently mentioned components are "skill or competency focus" (f=10), "connection with traditional programs" (f=9), "assessment" (f=6), and "quality and accreditation" (f=6). Additionally, components such as flexibility (f=4), relevance to the workplace and employers (f=2), and short duration (f=2) have been identified.

As the fourth Sub-theme, the structures that participants believe are similar to micro-credentials have been examined. The findings are presented in Table 5.

Table 5. *Existing Structures Similar to Micro-Credentials*

Sub-theme 4 – Existing Structures Similar to Micro-Credentials	f
1. *University Applications:*	
– Courses offered by Lifelong Learning Centers or Continuing Education Centers	4
– Undergraduate courses	3

– University partnerships	3
– Erasmus Mobility	2
– Non-thesis Master's Programs	1
2. *Non-University Applications:*	
– Public institutions (e.g., Ministry of Education, Ministry of Industry)	4
– Private organizations (e.g., MOOCs)	4

Table 5 shows that participants most frequently likened micro-credentials to courses offered at "Lifelong Learning Centers" or "Continuing Education Centers" within universities (f=4). Additionally, some courses at the undergraduate level (f=3) and university-industry partnerships (f=3) were also considered comparable to micro-credentials. Some participant views are as follows:

> *"…training programs are provided at lifelong learning centers that are targeted at specific areas, have a defined program, are monitored, then tested, and certified" (P2).*

> *"There is something called a sector campus, managed by the Ministry of Industry. Large companies are engaged, such as Turkcell, Arçelik, or Vestel. People interested in providing education are found. They develop programs within a curriculum. For instance, someone from Turkcell teaches an artificial intelligence course. Partner universities direct their students here, and these are accepted in the curriculum in exchange for something. This might be one of the first examples of micro-credentials being implemented in Turkey… our students can take this course, and the grades they receive can count as technical elective credits." (P5)*

Regarding non-university applications, skill-focused training provided by public institutions (f=4) and MOOCs (f=4) were noted as being similar to micro-credentials. The participant's views on this are:

> *"The Ministry of National Education has released new report cards. Did you see them? On the left side, there are grades, and on the right side, there are behavior scores. They have changed those behavior scores. They have defined four levels for artistic and sports activities, such as participation, performance, and awards. On the right side, there is a scale that continues from school, district, and provincial levels to national and international levels. I think this is also a micro-credential. It will likely be binding for universities as well." (P7).*

> *"MOOCs are available. There are courses there. I also took some, especially during the pandemic. Like Udemy and Coursera. Those courses are also a kind of micro-credential. There are courses according to your needs; you participate, learn something for a certain period, there is an evaluation at the end, and you can get a certificate. You can prove what you have learned or not learned" (P3).*

The fifth sub-theme examined views on the institutional implementation of micro-credentials. The findings are presented in Table 6.

Table 6. *Views on Institutional Structuring of Micro-Credentials*

Sub-theme 5 - Type of Institutional Structure	f
1. External stakeholders as providers and universities in recognition roles	6
2. Universities as providers and recognition bodies	4
3. Sector-University Collaborations	4
4. Identification of accredited training institutions	3
5. Consortia (University Partnerships)	2
6. Action according to industry supply under the umbrella of the Council of Higher Education (CoHE), Vocational Qualifications Authority (VQA), and Ministry of National Education (MoNE)	2
7. Departments as decision-makers	1

According to Table 6, most participants believe that external stakeholders, such as MOOC providers or public institutions, should serve as providers, while universities should be responsible for the recognition of micro-credentials (f=6). One participant expressed their views as follows:

> *"IBM should come and open a workshop in Turkey where students can learn a programming language up to a certain level. When they come back, I should be able to assess them or accept the certificate they received. The distance education part is complete. Of course, on an international level, they might have to go abroad. But I am personally against universities managing this on their own because if I could provide the necessary training, I should be able to offer it within my unit." (P10)*

Moreover, it was also emphasized that the implementation of micro-credentials should be under the initiative of universities (f=4). In other words, it was suggested that universities should assume both provider and recognition roles. One participant commented:

> *"The evaluation mechanism of Continuing Education Center courses could be strengthened and turned into micro-credits. Especially research universities could lead this. Who will be responsible for implementing micro-credentials in our institution? The educational coordination office? The distance education center? The exemption commissions? We need a commission with representatives from each department." (P6)*

Additionally, some participants suggested that applying micro-credentials through university-sector collaborations (f=4) would be more effective. A participant expressed their views as follows:

> *"Higher education cannot solve this issue on its own. The purpose of micro-credentials is to develop skills for the job market, or what we call reskilling and upskilling. With the rapid advancements in artificial intelligence and other fields, it is becoming increasingly difficult for someone with outdated knowledge to continue in their career. For those who are already in the workforce, what value do these micro-credentials offer? Perhaps the Ministry of Labor and Social Security, similar to vocational qualification institutions, can collaborate with other government agencies for the regulation of professional qualifications. This is not something that higher education alone can address." (P4)*

Furthermore, recommendations include identifying internationally recognized accredited training institutions (f=3), forming university partnerships (f=2), and managing the process under the coordination of the Council of Higher Education (CoHE), Vocational Qualifications Authority (VQA), and Ministry of National Education (MoNE) (f=2).

As the sixth sub-theme, participants' views on the importance of micro-credentials have been examined. The findings are presented in Table 7.

Table 7. *Importance of Micro-Credentials*

Sub-theme 6 - Importance	f
1. Supporting quality and equitable education	7
2. Increasing employment	6
3. Responding to changing learner needs	5
4. Addressing skill gaps due to changing job conditions (upskill and reskill)	4
5. Supporting innovative pedagogies	4
6. Providing flexibility in learning	3
7. Promoting lifelong learning	3

8. Increasing the institution's revenue and reputation	2
9. Connecting disciplines	1
10. Tool for obtaining feedback from the sector	1
11. Supporting professional development and workplace training	1
12. Creating a competitive environment for metropolitan areas	1

When examining Table 7, the most frequently expressed views on the importance of micro-credentials are "supporting quality and equitable education" (f=7), "increasing employment" (f=6), and "responding to changing learner needs" (f=5). Other important aspects include addressing skill gaps due to changing job conditions (f=4), supporting innovative pedagogies (f=4), providing flexibility in learning (f=3), and promoting lifelong learning (f=3). Some participant opinions on the topic are as follows:

> *"University programs may not address sector requirements, so students might wish to enhance themselves with additional training. Universities need to act proactively in this regard, bringing it to the forefront and designing relevant systems. This is crucial for both serving society and improving the employability of our students. For example, if you have been working as an accountant for fifteen years and need to learn new software, where will you gain this competency, or if you need to change professions? There is an increasing need for micro-credentials in professional life, both for acquiring new skills and updating existing ones." (P3)*

> *"These are not pieces of information that can be obtained simply by reading. They are very current... and there are no such sources available. However, when we listen to experts, we save time and learn a lot." (P9)*

Practice of Micro-Credentials

According to the findings obtained in the study, the second main theme was determined to consist of the participants' views on their practices of micro-credential. In this context, the seventh sub-theme explores the participants' experiences with micro-credentials. The findings are presented in Table 8.

Table 8. *Experiences of Facultys with Micro-Credentials*

Sub-theme 7 - Experience	f
1. Participation as a student in MOOCs	6
2. No experience	4
3. MOOC design / instructing	3

According to Table 8, most participants have engaged with MOOCs as students (f=6), while fewer have been involved in MOOC design or instructing (f=3). There are also participants who reported having no experience with micro-credentials (f=4). Some participant views on the topic are as follows:

> *"I took a course from something called Istanbul Academy. It was quite rigorous, with exams and live classes that I could attend, and if I missed them, I could watch the recordings. There were exams for certification. There is also Khan Academy." (P2)*

> *"We conducted a project with the British Council to shift faculty members' perspectives towards student-centered learning. The goals were developed by the Turkish Higher Education Quality Council (THEQC). I was part of the design team. We designed an advanced teaching package for this purpose. It was a program spread over about 45 hours, including 16 hours face-to-face." (P8)*

> *"Our university has a Lifelong Learning Center. Last semester, we launched a Certificate Program for Sustainable Development Goals related to Climate Change. I was involved in both the design and the training process." (P9)*

As the eighth sub-theme, participants' views on the existing institutional infrastructure and resources that would facilitate the implementation of micro-credentials in higher education were examined. The findings are presented in Table 9.

Table 9. *Existing Infrastructure and Resources of Universities for Implementing Micro-Credentials*

Sub-theme 8 - Infrastructure and Resources	f
1. Distance education technical infrastructure	4
2. Infrastructure of faculties and institutes (e.g., non-thesis master's programs, open education, technopolis collaborations)	4
3. Support from senior management	3
4. Expertise of academic staff	3
5. Infrastructure of lifelong learning or continuing education centers	1

According to Table 9, the most frequently mentioned supportive elements in the implementation of micro-credentials are distance education technical infrastructure (f=4), infrastructure of faculties and institutes (f=4), support from senior management (f=3), and expertise of academic staff (f=3). One participant referred to the Lifelong Learning Center or Continuing Education Center as an infrastructure/resource. A participant who noted improvements in distance education infrastructure, especially during the pandemic, expressed their views as follows:

> *"Due to both the pandemic and the earthquake, the distance education infrastructure has been established in all universities, so the same infrastructure could have been easily provided here as well. Therefore, I don't think there will be any problems in conducting the process through distance education at the university. There is all the necessary infrastructure available, and we don't have a serious problem with integrating it into the curriculum." (P5)*

Other participants' views on the topic are as follows:

> *"The management's support in this matter is very significant. It's not yet a process, but management cares, so we're working on it. Research universities being pioneers in this area is critical." (P1)*

> *"If we were to open an internationally recognized program, we could easily introduce it to the market using UZEM's infrastructure." (P7)*

The ninth sub-theme examines the potential problems that might arise during the implementation of micro-credentials. The findings are presented in Table 10.

Table 10. *Problems in the Implementation of Micro-Credentials*

Theme 9 - Potential Problems		f
1.	Council of Higher Education (CoHE) regulations	9
2.	Lack of regulatory institutional strategies	9
3.	Time constraints	3
4.	Faculty issues	2
5.	Conceptual confusion	2
6.	Lack of Turkish-language platforms	1
7.	Perception as an additional workload	1
8.	Costs	1
9.	Commercialization	1
10.	Creation of inequality in opportunities	1

Examining Table 10, the most frequently mentioned problems are CoHE regulations (f=9), lack of regulatory institutional strategies (f=9), and time constraints (f=3). A problem related to CoHE regulations was noted by one participant as follows:

> *"Unless CoHE makes a change in the main legislation, any action we take may cause legal problems for us... A regulatory change is needed at the CoHE*

> *level... You are giving students credits and ultimately a diploma at a point where the framework is not defined, and the structure is not yet established. If a legal situation arises that might lead to the cancellation of these credits, students will suffer the consequences." (P5)*

Under the lack of regulatory institutional strategies, three subcategories were identified: a) remuneration, b) copyright and monitoring, and c) uncertainties in assessment and recognition. A participant's view on the issue is:

> *"When this professor publishes these resources as a book and puts it on the market, they will earn a lot of money. How can we tell a law professor to put all their lecture notes in open access without any compensation? Fine, let's make it open access for our own students, but if external students could buy it for a fee, and we give this fee to the professor." (P9)*

A participant discussing time constraints mentioned:

> *"It seems that concerns about academic publishing and lack of time stem from this. Extra time needs to be allocated for such innovative practices, or time management needs to be done well. It may be difficult for many academics to allocate time for this." (P8)*

An example of a participant noting resistance from faculty is:

> *"Everyone tends to resist new things. No, everyone will take my class; I teach this course best. There is a perception that no one else can teach this subject." (P10)*

Under the tenth sub-theme, the views of the participant faculties on the policies and studies on micro-competencies conducted by the institutions where they work were examined. The findings are presented in Table 11.

Table 11. *Policies and studies conducted by universities on micro-competencies*

Sub-theme 10 - Policies and Practices	f
1. Preparation at the initial stage	4
2. No activity	4
3. Detailed preparation in terms of regulations and implementation	2
4. No knowledge	2

Table 11 shows that in the universities where the participants work, either there is general preparation at the initial stage (f=4) or no work has been done yet (f=4) regarding the implementation of micro-credentials. A few institutions have reported detailed

preparation (f=2), while some participants (f=2) have stated that they have no knowledge of developments in this area. Some participant views on the topic are as follows:

> *"When a directive was issued on the recognition of prior learning, micro-credentials came up, and a directive study on micro-credentials was also conducted." (P3)*

> *"We have reached a sustainable cycle regarding this issue. As mentioned, infrastructure is important. Both the education staff and the competence of those requesting this training are important. These have been prepared and are ready in our university, but we have only produced the policy, so to speak." (P11)*

Sub-theme 11 explores the participants' views on the evaluation of micro-credentials. The findings are presented in Table 12.

Tablo 12. *Evaluation of Micro-Credentials*

Sub-theme 11 - Evaluation		f
1.	Clear and specific evaluation	5
2.	Flexibility in evaluation	4
3.	Competency/skill-based evaluation	4
4.	Process evaluation	3

According to Table 12, the most frequently emphasized aspects in the evaluation of micro-credentials are clear and specific evaluation (f=5), competency/skill-based evaluation (f=4), and flexibility in evaluation (f=4). Additionally, the necessity of process evaluation (f=3) is another highlighted element. Some participant views on the topic are as follows:

> *"We need to see the following in the certificate they receive: How many hours was it, what were the achievements? What was the exam based on? For example, in the European Union, they look at this. They categorize the certificate's value based on whether the exam was conducted under supervision, an online exam, or a portfolio-based assessment." (P3)*

> *"The evaluation should depend on the student, the graduate, and the type of micro-credential targeted. Not every micro-credential needs an exam. If the person is enthusiastic about learning and using it in their profession, we should differentiate whether they will use it professionally. However, for professional qualifications, which are all exam-based, the certificate must be validated through an exam to prove the qualification." (P2)*

"Let's specialize the tasks to truly understand what the student has gained and what remains with them. In today's higher education, we want to focus on skills. Therefore, we should implement multiple assessments differently. Measure their participation, how much time they spend, how long they remain in the system, track their classes, and assess the assignments and reflective writings periodically." (P7)

Twelfth and lastly, participants' views on the recognition and validation processes of micro-competencies were examined. The data obtained are presented in Table 13.

Table 13. *Process of recognition and validation of micro-competencies*

Sub-theme 12 - Recognition and Validation		f
1.	Diploma Supplement	6
2.	Clarity of recognition and validation criteria	4
3.	Linking with prior learning	2
4.	Department-level recognition	2

According to Table 13, the most frequently emphasized aspect of the recognition and validation process for micro-credentials is the use of diploma supplements (f=6). Ensuring clarity of criteria (f=4), linking with prior learning (f=2), and department-level recognition (f=2) are also noted. Some participants' views on the topic are as follows:

"A diploma supplement could be used. It should be separate from regular credits. Existing credits are already insufficient for acquiring competencies." (P2)

"I think the recognition should be well-structured. There should be flexibility, but to prevent misuse, the recognition principles should be well-developed. With the Bologna Process and the use of ECTS, it should be simple to calculate the ECTS credits for these courses based on workload. The workload should be clear in advance." (P4)

"If we convert equivalent competencies to the recognition of prior learning, it seems like an effortless solution. It seems much more logical to integrate it into the micro-credentialing framework." (P7)

Conclusion and Discussion

In this study, which investigated the opinions and expectations of faculty members regarding the integration of micro-credentials into higher education, interviews were conducted with 12 faculty members. It was found that almost all the interviewees have a positive perspective on the implementation of micro-credentials.

According to the research findings, there is no consensus among participants regarding the terminology of the concept. The term "micro-credentials" (EU, 2020) has been translated into Turkish as "mikro-yeterlilik," but it is believed that this term does not fully capture the concept. Many participants expressed that "micro-credits" might be a more suitable term. Additionally, some participants highlighted that this term is either not used or not well-known in institutions. In the national literature, Kozanoğlu (2021) used the term "micro-certificates," while Kır and Bozkurt (2022) used "micro-credit." The Vocational Qualifications Authority (VQA) has adopted the term "mikro-yeterlilik." Therefore, it can be argued that micro-credentials are not yet sufficiently conceptualized at the higher education level in Turkey.

The study found that most participants provided mid-level definitions of the concept, encompassing only certain aspects of it. Notably, participants who provided comprehensive and clear definitions of micro-credentials were those who had conducted academic work on the topic. Commonly emphasized components in participants' definitions of micro-credentials include connection with traditional programs, focus on skills or competencies, and methods of assessment. Other components mentioned include short duration, alignment with the workplace and employers, flexibility, quality, accreditation, and internationalization. These components resemble the definitions in reports outlining the fundamental features of micro-credentials (Bigelow et al., 2022; EU, 2020; Oliver, 2022). However, components such as short duration and alignment with the workplace and employers were mentioned by fewer participants.

Another finding of the research is that participants compared micro-credentials to various applications both within and outside universities. For example, courses offered by Lifelong Learning Centers or Continuing Education Centers within universities, vocational internships at the undergraduate level, and courses developed through university partnerships were likened to micro-credentials. Similarly, training or courses provided by the public or private sectors for specific purposes were also compared to micro-credentials. Participants related the characteristics of these trainings or courses, such as being created for specific needs and being short-term, including assessment and certification, to micro-credentials.

According to the research, participants proposed different models for the institutional implementation of micro-credentials. Most participants suggested that external stakeholders, such as MOOC providers or public institutions, should be the providers of micro-credentials, while universities should be responsible for recognition processes. In other words, they proposed that the development and distribution of micro-credentials

be handled by external stakeholders. On the other hand, some participants suggested models where sector-university collaborations and universities play roles in both provision and recognition. University partnerships were mentioned by very few participants. The general situation of micro-credential implementation reveals that two models are more common. The first model involves the development of micro-credentials in collaboration with MOOC providers, with MOOC providers handling distribution and universities being responsible for recognition processes. The second model involves universities creating, offering, and recognizing micro-credentials either independently or through partnerships. The second model is more commonly applied in countries such as the US, Canada, and Australia, while the first model is more prevalent in Europe. Since developing micro-credentials is a time-consuming process requiring infrastructure, the implementation of micro-credentials in higher education in Turkey may particularly begin through collaborations with MOOC providers during the initial stages.

Another significant finding from the study is that participants considered micro-credentials important due to their potential to support quality and equitable education, increase employability, and address changing learner needs. Other benefits mentioned include supporting innovative pedagogies, providing flexibility in learning, promoting lifelong learning, and closing skills gaps due to changing job conditions. Participants' views on the importance of micro-credentials align with studies highlighting these aspects (Che Ahmat et al., 2022; EU, 2020; McGreal et al., 2022; Msweli et al., 2022; Oliver, 2022). However, factors such as developing 21st-century skills and reducing educational costs, which are highlighted in the literature, were not mentioned in this study.

The study revealed that most participants have limited experience with micro-credentials. Some participants reported participating in MOOC courses as students, while others mentioned their involvement in design and teaching processes. However, there were no reports of taking micro-credential courses or being involved in their design. The faculty members participating in this study are those who attended VQA's workshop, indicating a certain level of awareness about micro-credentials and being among decision-makers at their universities. Although they reported developing some level of awareness after the workshop, it can be suggested that they have not yet been actively involved in the design and implementation processes of micro-credential courses. This may be due to the absence of concrete steps for implementing micro-credentials at the CoHE level and the unclear roadmap for micro-credentials in Turkey. In such uncertainty, faculty members may be reluctant to dedicate time and effort to micro-credentials.

According to the participants, facilitators for implementing micro-credentials in higher education include distance education infrastructure, support from top management, faculty expertise, and program infrastructure in faculties and institutes. It is known that universities' distance education infrastructure has significantly developed during the pandemic. However, the adequacy of existing distance education infrastructures for designing, distributing, and recognizing micro-credentials is unknown. It is

recommended to conduct studies in this regard. Additionally, faculty expertise, motivation, and management support are crucial in creating micro-credential content. Establishing a team or unit to manage the process of designing micro-credentials at the university level, making decisions based on the expertise of instructional designers, and developing institutional policies are also critical.

Another important finding of the study is that participants identified CoHE regulations and the lack of regulatory institutional strategies as the most likely problems in the implementation of micro-credentials. Indeed, a letter sent by CoHE to universities halted existing work on micro-credentials, stating that work could resume after the establishment of a framework by CoHE. CoHE plays a decisive role in higher education policies and structures in Turkey, and changes can be made within the limits allowed by regulations. Accordingly, the structure and decisions made by CoHE regarding the implementation of micro-credentials in universities will also be crucial. Similarly, since the extent of flexibility granted to universities is unknown, regulatory institutional strategies are expected to be somewhat dependent on CoHE regulations. In countries like Europe and the US, where micro-credentials are widely used, regulatory issues have largely been overcome. Other problems in the implementation process of micro-credentials include faculty resistance, lack of time, cost, and commercialization of universities. Similar problems are also discussed in literature (Clausen, 2022; Kozanoğlu, 2021; Murgatroyd, 2022; Stefaniak & Carey, 2019). It is particularly important to address faculty resistance and raise awareness about the potential of micro-credentials.

Regarding the policies and practices related to micro-credentials in institutions, it was observed that generally, either preparation is in the initial stages, or no work has yet been done. According to the findings, only a few institutions have made detailed preparations for the implementation of micro-credentials. Another important finding is that faculty members do not have detailed information about this topic.

In the process of evaluating micro-credentials, which is also a significant topic in literature, the most emphasized view is the need for clear and transparent evaluation. The necessity of competency/skill-based assessment was also highlighted by the participants. Flexible assessment and process-oriented evaluation were other views reached. Similar views on evaluation, which is one of the most critical aspects of micro-credentials, are also highlighted in the literature (Murgatroyd, 2022; Olcott, 2021; Ralston, 2021; Thi Ngoc Ha et al., 2022).

Another finding directly related to institutional structuring and policies is the process of recognition and validation of micro-credentials. The necessity of using diploma supplements and linking with prior learning was emphasized. Additionally, ensuring the clarity of criteria was highlighted as important in the evaluation process and in this theme. The necessity of recognition at the departmental level, related to institutional structuring, was also mentioned by the participants. Recognition is one of the most debated topics regarding micro-credentials. Although efforts are being made to create policies and

standards, uncertainties regarding recognition, especially in extracurricular areas, continue.

This study provides significant contributions to the national literature by deeply presenting the views of key faculty members in different institutions on various aspects of micro-credentials, from definition to recognition, which have not yet been integrated into higher education in Turkey but are planned. The study has some limitations. Firstly, participation in the research was based on voluntary willingness, and interviews were conducted with faculty members willing to participate. The study can be repeated with more participants from different regions of the country. Secondly, data was collected only through interviews in this study. Data could also be collected through surveys and examination of reports to present more comprehensive results on the topic. Thirdly, data collection from other key stakeholders in higher education, such as students and administrators, could provide a broader perspective on the integration of micro-credentials into higher education.

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Genişletilmiş Türkçe Özet

Son yıllarda oldukça önem kazanan bir kavram olan mikro-yeterlilikler, talep edilen bilgi birikimi, beceri ve deneyimi sağlamak üzere tasarlanmış kısa ve odaklı kredilerdir. Biriktirilen mikro-yeterlilikler ayrıca bir sertifika ya da dereceye giden bir yol sağlayabilir. Mikro-yeterlilikler, yükseköğretimde öğrenme ve öğretimin geleceği üzerinde önemli bir etkiye sahip olacak teknoloji ve uygulamalar arasında yer almaktadır (Pelletier vd., 2023). Uluslararası düzeyde benimsenen farklı yaklaşım ve uygulamalar nedeniyle mikro-yeterlilikler farklı ülkelerde ve farklı sağlayıcılar tarafından çeşitli şekillerde tanımlanmış ve etiketlenmiştir (Resei, Friedl, Staubitz ve Rohloff, 2019). Örneğin, mikro-yeterlilik yerine dijital yeterlilik, alternatif yeterlilik, dijital rozet, mikro-derece ve nanoderece gibi terimlerin eşanlamlı olarak kullanıldığı görülmektedir. Ayrıca, oluşturulan birkaç saatlik çok kısa derslerin, mevcut diploma veya derece derslerinden bazılarını biraraya getirerek oluşturulan kümelerin ve yeterliliklerden bağımsız olarak sadece bilgi ve anlayış geliştirmeye odaklanan derslerin mikro-yeterlilik olarak sunulması, ortaya çıkan manzarayı oldukça karmaşık ve dağınık hale getirmiştir (Cedefop, 2022; Oliver, 2021). Bu nedenle, mikro-yeterliliklere yönelik ortak bir anlayışı teşvik etmek ve kullanımına ilişkin farkındalığı artırmak üzere çalışmalar yapılmasına ihtiyaç duyulmuştur.

Dünya çapında üniversiteler arasında mikro-yeterliliklerin uygulanmasına yönelik artan ilgi ve çabalar söz konusu olsa da yükseköğretime mikro-yeterliliklerin entegrasyonu konusunda henüz başlangıç aşamasında bulunulmaktadır. Mikro-yeterliliklerin yükseköğretime entegrasyonunun önünde mikro-yeterliliklerin tasarlanması, uygulanması ve tanınmasına ilişkin politika ve düzenlemelerin eksikliği, paydaşların mikro-yeterliliklerle ilgili düşük farkındalıkları, yetersiz teknik altyapı ve öğretim elemanlarının dijital yeterliklerinin olmaması vb. engeller bulunmaktadır (Clausen, 2022; Stefaniak ve Carey, 2019). Üniversite ve endüstri liderlerinin katıldığı yakın tarihli bir uluslararası araştırmanın sonuçları, mikro-yeterlilikler ile ilgili olarak üzerinde anlaşmaya varılmış standartlar ve kalite güvencesi konusunda eksiklikler olduğunu ve bu nedenle mikro-yeterliliklerin henüz geniş çapta kabul görmediğini ortaya koymaktadır (Holon IQ, 2021). Bu noktada, mikro-yeterliliklerin kurumun vizyonuna başarılı biçimde entegre edilmesi, yükseköğretim liderlerinin tüm kilit paydaşlara mikro-yeterliliklerin önem ve değerini net olarak anlatması ve olası potansiyelleri konusunda ikna edici planları sunması gerekmektedir (Olcott, 2021).

Bu çalışmanın amacı, yükseköğretimde öğrenme ve öğretmenin geleceği üzerinde önemli bir etkiye sahip olacağına inanılan mikro-yeterliliklerle ilgili olarak öğretim elemanlarının görüş ve beklentilerini incelemektir.

Araştırmada nitel araştırma yöntemlerinden fenomenolojik yaklaşım izlenmiştir (Creswell,2017). Bu kapsamda araştırmada ölçüt örnekleme tekiniği ile belirlenen 2023-2024 öğretim yılı güz döneminde Ankara'da Mesleki Yeterlilik Kurumu tarafından düzenlenen "Mikro-yeterlilik Çalıştayına" katılım gösteren 12 öğretim elemanı ile görüşmeler yapılmıştır. Bu çalıştaya çağrılan katılımcılar kendi üniversitelerinde mikro-

yeterliliklerin kurumsal düzeyde entegrasyonu üzerine çalışan kilit öğretim elemanlarıdır. Araştırmada öğretim elemanlarının mikro-yeterliliklere ilişkin algıları ve deneyimlerini derinlemesine inceleyebilmek amacıyla araştırmacılar tarafından geliştirilen ve açık uçlu sorulardan oluşan yarı yapılandırılmış görüşme formundan yararlanılmıştır. Elde edilen verilerin analizi sonucunda konuya ilişkin 2 ana tema altında 12 alt-tema oluşturulmuştur. Her bir tema alt temaları çerçevesinde incelenerek frekansları ve doğrudan alıntıları ile birlikte bulgular başlığı altında detaylı şekilde sunulmuştur.

Araştırma sonucunda mikro-yeterlilik kavramın isimlendirmesi konusunda katılımcılar arasında bir fikir birliği bulunmamaktadır. Bu doğrultuda, mikro-yeterliliklerin ülkemizde yükseköğretim düzeyinde henüz yeterince kavramsallaşmadığı ileri sürülebilir. Çalışmada, kavramın tanımlanması konusunda katılımcıların çoğunun kavramın sadece belirli özelliklerini içeren orta düzey tanım sundukları belirlenmiştir. Katılımcıların mikro-yeterlilik tanımlarında en sık vurguladıkları bileşenler geleneksel programlarla bağlantı, beceri ya da yeterlik odağı ve değerlendirme şeklindedir. Bunların yanında, kısa süre, işyeri ve işverenle uygunluk, esneklik, kalite ve akreditasyon ve uluslararasılık gibi bileşenler de ifade edilmiştir.

Katılımcıların mikro-yeterlilikleri üniversite içi ve dışındaki farklı uygulamalara benzetmekle beraber, mikro-yeterliliklerin kurumsal düzeyde yapılanmasına yönelik katılımcı görüşleri farklı modeller ortaya koymaktadır. Katılımcıların çoğu MOOC sağlayıcılar ya da kamu kurumları gibi dış paydaşların mikro-yeterlilik sağlayıcı iken üniversitelerin tanınma süreçlerinden sorumlu olması gerektiğini belirtmişlerdir.

Araştırmadan elde edilen bir başka sonuca göre, katılımcılar mikro-yeterlilikleri özellikle kaliteli ve eşit eğitimi destekleme, istihdamı artırma ve değişen öğrenen ihtiyaçlarına cevap verme potansiyellerinden dolayı önemli bulmuşlardır. Ancak bunun yanında katılımcıların çoğunun mikro-yeterliliklere ilişkin deneyimlerinin sınırlı olduğu belirlenmiştir.

Araştırmada katılımcılara göre, uzaktan eğitim altyapısı, üst yönetim desteği, öğretim elemanı uzmanlığı ile fakülte ve enstitülerin program altyapıları mikro-yeterliliklerin yükseköğretimde yuygulanmasını kolaylaştıracak olanaklardır. Bunun yanında katılımcılar, mikro-yeterliliklerin uygulanması sürecinde en fazla karşılaşılabilecek problemlerin Yüksek Öğretim Kurulu (YÖK) mevzuatı ve düzenleyici kurumsal stratejilerin eksikliği olduğunu ifade etmişlerdir. Nitekim, YÖK tarafından üniversitelere gönderilen bir yazı ile mikro-yeterliliklere ilişkin yapılan mevcut çalışmaların durdurulması bildirilmiş ve YÖK tarafından oluşturulacak bir çatı sonrasında çalışmalara devam edilebileceği belirtilmiştir.

Mikro-yeterliliklerin uygulanmasına ilişkin kurumlarda yürütülen politika ve çalışmalara yönelik katılımcıların görüşleri incelendiğinde genel olarak ya başlangıç aşamasında hazırlık yapıldığı ya da henüz çalışma yapılmadığı görülmektedir. Elde edilen bulgulara göre henüz mikro-yeterliliklerin uygulanmasına yönelik olarak az sayıda kurumun

detaylı hazırlık yapmış olduğu söylenebilir. Yine öğretim elemanlarının bu konuya ilişkin detaylı bilgiye sahip olmamaları da önemli bir bulgu olarak karşımıza çıkmaktadır.

Alan yazında da önemli bir yer kaplayan mikro-yeterliliklerin değerlendirilmesi sürecine ilişkin en çok vurgulanan görüş açık ve net değerlendirme yapılmasıdır. Yeterlilik/beceri odaklı değerlendirmenin gerekliliği de katılımcılar tarafından vurgulanmıştır. Esnek değerlendirme ve süreç odaklı değerlendirme ise diğer ulaşılan görüşler arasındadır.

Mikro-yeterliklere ilişkin kurumsal yapılanma ve hazırlanan politikalarla da doğrudan ilişkili olan bir diğer bulgu mikro-yeterliliklerin tanınması ve doğrulanması sürecine ilişkindir. Konuya ilişkin olarak diploma eki kullanımı ve önceki öğrenmelerle ilişkilendirme yapılması gerekliliği vurgulanmıştır. Bunun yanında ölçütlerin netliğinin sağlanması da değerlendirme sürecinde vurgulandığı gibi bu tema altında da vurgulanmıştır.

Bu çalışma henüz ülkemizde yükseköğretime entegre edilmemiş ancak planlaması yapılan mikro-yeterliliklerin tanımlanmasından tanınmasına kadar farklı boyutları hakkında farklı kurumlardaki kilit öğretim elemanları görüşlerini derinlemesine ortaya koyması açısından özellikle ulusal alanyazına önemli katkılar sağlamaktadır. Çalışmanın bazı sınırlılıkları bulunmaktadır. Öncelikle, araştırmaya katılım gönüllük esasına dayanmıştır ve çalışmaya katılım göstermeye istekli öğretim elemanları ile görüşme yapılabilmiştir. Ülkenin farklı kesimlerinden daha fazla katılımcıyla görüşmeler yapılarak çalışma tekrarlanabilir. İkincisi, bu çalışma kapsamında sadece görüşme yoluyla veri toplanmıştır. Anket ve raporların incelenmesi yollarıyla da veri toplanıp konuya ilişkin daha bütüncül sonuçlar ortaya konulabilir. Üçüncüsü, yükseköğretimdeki diğer kilit paydaşlar olan öğrenciler ve yöneticilerden veri toplanıp mikro-yeterliliklerin yükseköğretime entegrasyonu daha geniş bir perspektiften incelenebilir.

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