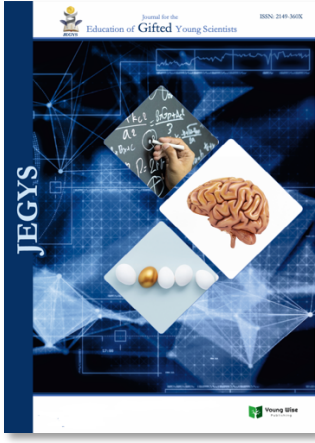






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From the Editor

Dear Education Researchers,

We are pleased to present the September issue of the *Journal for the Education of Gifted Young Scientists (JEGYS)*, continuing our mission to advance the field of education through innovative, interdisciplinary, and evidence-based research. With a special focus on gifted and advanced learners, this issue once again offers original contributions that aim to enrich scholarly discussions and inspire future research.

This edition features four diverse and thought-provoking articles. The first article, *"An investigation into the social validity of differentiated instruction for gifted students supported by augmented reality on the topic of historical places"* by Derya Sönmez, explores how augmented reality can enhance differentiated instruction, providing meaningful learning experiences for gifted learners while deepening their understanding of historical contexts.

The second article, *"Examination of teachers' views on the development of pre-school children's thinking skills"* by Hatice Ceylan Sağkaya and Sevil Filiz, offers valuable insights into educators' perspectives on fostering critical and creative thinking in early childhood, highlighting practical approaches to support cognitive development from the earliest stages of education.

The third contribution, *"Mathematically precocious children in early childhood: A systematic review"* by Hacer Elif Dağlıoğlu and Elifnur Sarıkoca Işgın, provides a comprehensive synthesis of current research on young mathematically gifted learners, emphasizing the importance of early identification and tailored educational strategies.

Finally, *"Service innovation in enhancing academic quality at private higher education institutions in Gorontalo: a theoretical conceptual model analysis of innovation diffusion using the SEM-PLS approach"* by I Kadek Satria Arsana, Ansar, Hasim, Juriko Abdussamad, and Yanti Aneta, examines how innovative practices in higher education contribute to academic quality, offering a conceptual model that has significant implications for institutional development and educational policy.

We believe that the articles in this issue will broaden perspectives, spark new discussions, and provide meaningful contributions to the fields of gifted education, early childhood development, instructional innovation, and higher education. As always, we invite scholars, educators, and practitioners to share their research with JEGYS and join us in shaping the future of educational excellence.

Warm regards,

JEGYS Editorial Team

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Abstracting & Indexing

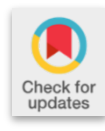
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Research Article

An investigation into the social validity of differentiated instruction for gifted students supported by augmented reality on the topic of historical places

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Augmented reality
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Abstract

In the rapidly changing world of the 21st century, technology-focused skills are reflected in educational environments in order to help individuals achieve success. Augmented reality applications are among the most important applications used in education. The aim of this research is to examine the social validity by determining the opinions of gifted students on augmented reality-supported differentiated instruction about historical places. In this research, a case study design, one of the qualitative research methods, was used. The hypothesis of the research is expressed as “the opinions of gifted students regarding augmented reality-supported teaching of historical places are positive.” The participants of the research consist of 12 gifted primary school 3rd grade students studying in a science and art center located in the Eastern Mediterranean Region of Türkiye in the 2024-2025 academic year. The activity self-assessment form was used as the data collection tool. Descriptive analysis was used in the analysis of the data. The data obtained from the self-assessment form was transferred to writing without changing the student opinions. It was determined that the students had positive opinions regarding the teaching of historical places supported by augmented reality. It was determined that it provided permanent, fun and concrete learning for the students. Having different options while downloading the augmented reality application was seen as a difficulty. Activities can be designed for different lessons, topics and contents related to augmented reality, especially in teaching abstract concepts.

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Introduction

Today, the development levels of societies progress in direct proportion to the science and technology they create (Karasar, 2004). Therefore, educational environments cannot be considered independently of science and technology. Developments in technology are reflected in educational environments. As stated in the Ministry of National Education Life Science Curriculum, the rapid change in science and technology, the changing needs of the individual and society, innovations and developments in learning and teaching theories and approaches directly affect the roles expected from individuals. This change defines an individual who produces knowledge, can use it functionally in life, can solve problems, thinks critically, is enterprising, determined, has communication skills, can empathize, contributes to society and culture, etc. In order for all these processes to take place, technological developments must be reflected in educational environments (Özden Çınar, 2022).

Digital competence is one of the eight key competencies in the Turkish Qualifications Framework (TYÇ) (Demirbaş and Demir, 2018). Since Turkish education system aims to raise individuals with knowledge, skills and behaviors

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integrated with competencies, the use of augmented reality technology in the education process is important in developing digital competence skills.

Augmented reality (AR) is a technology that combines the real world with digital information. AR applications that offer real-time interactive environments allow users to see objects in three dimensions by combining real and virtual features (Daniela and Lytras, 2019; Özeren and Top, 2023; Turan and Atila, 2021). Three common features of augmented reality are as follows; Integration of virtual and real objects in the real world, their real-time interaction with each other, and the appropriate blending of real and virtual objects in interaction (Azuma et al. 2001).

AR applications are used in education and training processes to develop cognitive and affective skills (Jamali et al., 2014; Yılmaz and Batdı, 2016). Using augmented reality technology in the classroom environment increases the rate of participation in the lesson and supports group work, makes learning fun, increases motivation and provides effective and permanent learning (Önal, 2017). It can be used to concretize abstract concepts; It enables the subjects to be enriched with 2D models, 3D models, animations and videos. Apart from these, there are also dimensions that will save time, space and money, such as going to places that cannot be visited and seeing things that cannot be seen. For this reason, augmented reality-supported teaching of historical places can be transformed into a different, memorable and interesting activity by integrating the real world and the virtual. Considering the reflection of all these on the education process, the use of augmented reality technology in education has become increasingly widespread both in the world (Aslan, 2021).

Augmented reality technology offers opportunities in the education of all students as well as in the education of gifted students and helps them to realize their potential. The education of gifted individuals, who constitute approximately 2% of societies; raising them as individuals who produce and think about social benefit is important in terms of determining the welfare of society, its future and its position against world countries (Ünal and Er, 2015). Therefore, it should be considered important to raise gifted students who are technologically equipped. In this context, the inclusion of augmented reality in the education process and the presentation of content with materials developed with this technology will be intriguing for these students and will enable permanent learning, as well as increase awareness of augmented reality technologies.

Teaching about historical places allows students to act like historians and develop historical empathy skills. It also develops students' skills, analysis and evaluation abilities. In addition, teaching about historical places helps students become aware of national cultural values (Yesilbursa, 2008). In this respect, integrating historical place teaching with technology and using augmented reality application will also facilitate the achievement of the goals of The Century of Türkiye Education Mode. Bringing historical places that are too far to go to the classroom environment using augmented reality application is an indicator of the usefulness of technology in educational environments. Teaching about historical places with augmented reality supported by special talented primary school students will also enable these students to develop national consciousness by knowing their own history and culture, and the ability to evaluate historical changes by using technology effectively.

The basic approach of the curriculum in the The Century of Türkiye Education Mode, which aims to reach the peak of national and spiritual values and material development, aims to develop students' information, culture, digital and citizenship literacy skills with the mission from roots to the future and to make them patriotic, competent and virtuous people. With social science field skills, students will be able to develop time perception and chronological thinking, historical empathy and spatial thinking skills (Ministry of National Education [MEB], 2024a). In this context, the relationship between The Century of Türkiye Education Mode and the augmented reality-supported teaching of historical places for the gifted students addressed in the project has been revealed. The Science and Art Center (BİLSEM) Support Education Framework Curriculum, prepared as a skill-based program within the scope of The Century of Türkiye Education Mode, aims to increase national awareness by knowing the history and culture of gifted students, to develop the ability to evaluate historical changes by using technology effectively, and to develop critical thinking and scientific research process skills (MEB, 2024b). In line with this purpose, the project is related to the BİLSEM Support

Education Framework Curriculum, as the augmented reality-supported teaching of historical places for gifted students is addressed.

Aim/problem of the Study

The aim of the research is to determine the opinions of gifted students regarding the teaching of historical places supported by augmented reality.

The research question of the study is "What is the social validity of augmented reality-supported differentiated instruction practices on the topic of historical places for gifted students?" The sub-research questions of the study are as follows;

- What did gifted students learn from teaching historical places with augmented reality support?
- What did gifted students enjoy most about teaching historical places with augmented reality?
- What did gifted students find difficult in teaching historical places with augmented reality support?
- What is the gifted student's suggestion for teaching historical places with augmented reality support?

Method

Research Model

In this study, which determined the opinions of gifted students regarding the teaching of historical places supported by augmented reality, a case study design, one of the qualitative research methods, was used. A case study is a research method that is based on the questions of "how" and "why" and allows the researcher to examine in depth a phenomenon or event that he/she cannot control (Yıldırım and Şimşek, 2018; Creswell, 2017). A case study was selected as the research model because it was the most appropriate design for the structure of the research to examine the student opinions regarding the teaching of historical places supported by augmented reality in detail and in depth.

Participants

The Onikişubat Science and Art Center located in the Onikişubat district of Kahramanmaraş province, Turkey, in the 2024-2025 academic year. The participants were 6 girls and 6 boys, aged 8-9. They had no previous experience with augmented reality technologies. This study is a qualitative research and the easily accessible case sampling method was preferred among the purposeful sampling methods since it is easier to access the participants of the study (Yıldırım and Şimşek, 2018).

Augmented Reality Application Process

For the teaching of historical places supported by augmented reality, the augmented reality historical place cards in Appendix 1 were used. First, the PTT Augmented Reality (PTTAR) application was requested to be installed on the tablet or phone. The installed application was opened and the augmented reality historical place cards in Appendix 1 (2nd Term Grand National Assembly, Sultan Ahmet Mosque, Bursa Ulu Mosque, Galata Tower, Maiden's Tower, Hagia Sophia Mosque, Anıtkabir) were scanned by the camera (Appendix 1A/1B/1C/1D/1E/1F/1G). The three-dimensional visual and audio information of the relevant historical place was opened. The students were allowed to see and examine all the determined historical places. After the application, the students were asked to make a self-assessment in order to determine their opinions about the activity. Measures were taken to ensure that this study was carried out in accordance with ethical rules in all processes.

Data Collection Tool

The activity self-evaluation form was used as a data collection tool (Appendix 2). The self-evaluation form was created by the researcher. Two experts were consulted for the questions in the self-evaluation form before the research. The self-evaluation form included 4 (four) open-ended questions.

In order to ensure the internal validity of the study, the opinions of two experts were sought for the self-assessment form created by the researcher for use in the study. Experts provided feedback on the form's clarity, content validity, and age-level suitability. In line with this, language simplification was made in 2 questions. Necessary arrangements and additions were made in line with the expert opinion. For the self-assessment form prepared, two teachers who did not participate in the study were asked to read the forms and evaluations were made in terms of readability and

understandability of the questions. The self-assessment form was reorganized in line with these evaluations. It took approximately fifteen minutes for the students to answer the questions in the self-assessment form.

Data Analysis

Descriptive analysis was used in the analysis of the data. Descriptive analysis is an analysis technique in which direct quotes are frequently used to reflect the views of the interviewees in a striking way and the results obtained are interpreted within the framework of cause-effect relationships (Yıldırım and Şimşek, 2018). In descriptive analysis, the data are transferred as unchanged quotes as obtained from the interviewees. The data obtained from the self-assessment form, the opinions of the students were transferred to the writing without changing them. The names of the students were transferred from S1 to S12. The obtained data were read, and preliminary coding was determined. Similar codes were grouped, and themes were created. In order for this research to be valid and reliable, the data analysis process was explained in detail and sample quotations belonging to the categories created were included. In addition, the analyses were conducted by two different experts. In the analyses, it was determined that there was 80% agreement between the researchers. The reliability formula suggested by Miles and Huberman (1994) was used to determine this agreement percentage. $\text{Reliability} = (\text{consensus}) / (\text{consensus}) + \text{disagreement} \times 100$. In the concepts that could not be agreed upon, both researchers reached a common decision by discussing.

Findings

This section includes findings in line with the questions regarding the sub-objectives of the research. 4 themes, 7 categories and 16 codes were created in the research. These themes are education, teaching and learning, technological benefits and innovation, difficulties encountered, and suggestions.

Findings Regarding the First Sub-Problem and the Theme of Education, Teaching and Learning

The first sub-problem question is "What did I learn from teaching historical places supported by augmented reality?" In response to this question, students stated that they learned that they could see different historical places in the classroom using augmented reality technology (f:5), that the augmented reality application made learning easier (f:4), and that the Turkish and English voice-overs about historical places in the application provided information in different languages (f:3). In line with the data obtained from the first sub-problem, the theme of "Education, teaching and learning" was created. Table 1 includes the categories and codes related to the theme of education, teaching and learning.

Table 1. Category and code table for the theme of education, teaching and learning

Theme	Category	Code	Explanation
Education, training and learning	3D date to places oriented opinions	Accessibility	Reaching difficult the one which... date places class to the environment Moving
		Facilitation	Date places with information to learn facilitation, visual to learn to provide
		A lot Multilingualism	Different language Options with date places with relating to information of acquisition Providing
	Learning to the process oriented opinions	Concretization	History with relating to abstract concepts by concretizing learning process facilitation
		Virtual transport	Class to the environment virtual transport with date places Moving

In Table 1, in the category of views on 3D historical places in the theme of education, teaching and learning, the codes of accessibility, facilitation and multilingualism are included; in the category of views on the learning process, the codes of concretization and virtual transportation are included.

S2: "It allowed us to see historical places that we would not have been able to visit in the classroom."

S3: "The augmented reality application made our learning easier."

S9: "The fact that there are Turkish and English information voice-overs about historical places in the application was useful for us to gain information."

Findings Regarding the Second Sub-Problem and the Theme of Technological Benefits and Innovation

The second sub-problem question is "What did I enjoy most about teaching historical places supported by augmented reality?" In response to this question, students stated that seeing different historical places with augmented reality was interesting (f:4), enjoyable (f:4), and fun (f:4). In line with the data obtained from the second sub-problem, the theme of "Technological benefits and innovation" was created. Table 2 includes the categories and codes related to the theme of technological benefits and innovation.

Table 2. Category and code table for the theme of technological benefits and innovation

Theme	Category	Code	Explanation
Technological benefits and innovation	Insights into the application	Motivation	Making teaching about historical places enjoyable
		Attracting Attention	3D visuals and audio information of historical places provided attraction.
		Learning process	Facilitating the process of teaching historical places and providing visual learning
	Multilingualism	Intelligibility	Ensuring clarity with language options

In Table 2, in the category of views on application in the theme of technological benefits and innovation, the codes motivation, attention-grabbing, and learning process are included; in the category of multilingualism, the code of comprehensibility is included.

S1: "Seeing historical places in 3D was interesting and fun."

S4: "Learning about historical places in a classroom environment with augmented reality created interesting, fun and permanent learning."

S5: "This activity was very understandable and nice. I did not encounter any difficulties."

S7: "It was great to see historical places and get information. I wish we could go inside the historical places."

S11: "The augmented reality cards and application were remarkable. It provided visual learning."

Findings Regarding the Third Sub-Problem and Challenges Theme

The third sub-problem question is "What did I have difficulty with in teaching historical places supported by augmented reality?" In response to this question, students stated that having different options while downloading the augmented reality application made it difficult to download the application (f: 2) and some students stated that they did not have any difficulty (f: 10). The theme "Difficulties Encountered" was created in line with the data obtained from the third sub-problem. Table 3 includes the categories and codes related to the theme of difficulties encountered.

Table 3. Category and code table for the theme of challenges encountered

Theme	Category	Code	Explanation
Challenges encountered	Application installation issues	Having difficulty	The application has different download options
		No difficulties	No difficulties were encountered.

In Table 3, in the theme of difficulties encountered, the codes for experiencing difficulties and not experiencing difficulties in the application installation problems category are included.

S6: "We gained a different learning experience with this activity. There may be confusion in choosing when downloading the augmented reality application due to the different options."

Findings Regarding the Fourth Sub-Problem and Suggestion Theme

The fourth sub-problem question is "What is my suggestion for teaching historical places supported by augmented reality?". In response to this question, students suggested that the augmented reality application should include historical places in their own provinces (f:3), learning about augmented reality technologies (f:3), entering the historical

places in the application (f:3), some historical places could be more beautiful in the application (f:1), and the Çanakkale Martyrs' Monument should be among the augmented reality historical places cards (f:1). 2 students did not make any suggestions (f:2). The theme "Suggestion" was created in line with the data obtained from the fourth sub-problem. Table 4 includes the categories and codes related to the suggestion theme.

Table 4. Category and code table for the suggestion theme

Theme	Category	Code	Explanation
Suggestion	Proposal for the process	Getting information	Recommendations for learning more about AR
	Recommendation for implementation	Virtual Tour	Virtual tour feature by entering historical places
		Design	The visuals of some historical places could have been better
		National historical awareness	Proposal to give place to the Çanakkale Martyrs' Memorial
		The proximity principle	Suggestion that historical places in the city they live in should also have AR cards

In Table 4, in the suggestion theme, the process-oriented suggestion category included the information acquisition code; in the application-oriented suggestion category, the codes virtual tour, design, national history awareness, and proximity principle were included.

S7: "It was great to see historical places and get information. I wish we could go inside the historical places."

S8: "The implementations of some historical places could have been better."

S9: "I would suggest including the Çanakkale Martyrs' Monument among the augmented reality historical places cards."

S10: "We would also like to see augmented reality applications in the historical sites in our own province."

S12: "I want to learn about augmented reality technologies."

Conclusion and Discussion

In this section, the results obtained as a consequence of the research are discussed in line with the research questions. Based on what is learned in the augmented reality-supported teaching of historical places expressed in the first sub-problem of the research, it was concluded that gifted students learned visualization, applied learning, learning with fun, collaborative learning, concretizing abstract concepts and integrating technology-supported education methods into lessons in augmented reality-supported education. This result is similar to the studies conducted by Akın and Kızılaslan Tuncer (2024), Aktaş (2023), Akyol and Anıl (2024), Önal and Önal (2021) in the literature.

Based on what is enjoyed the most in the teaching of historical places supported by augmented reality, which is expressed in the second sub-problem of the research, it was concluded that gifted students enjoy learning by having fun and visual learning. This result is similar to the studies conducted by Aktaş (2023) and Uysal and Özdemir (2024) in the literature.

Based on the difficulties experienced in the teaching of historical places supported by augmented reality, which is expressed in the third sub-problem of the research, it was concluded that having different options while downloading the augmented reality application was seen as a difficulty for specially gifted students. This result is reported in the literature. It is similar to the studies conducted by Basumatary and Maity (2023), Özbey and Arıcı (2024).

Based on the suggestions regarding the augmented reality supported teaching of historical places expressed in the fourth sub-problem of the research, it was concluded that the gifted students wanted to see the historical places in their own provinces in practice in the augmented reality supported teaching of historical places, that they wanted the Çanakkale Martyrs' Monument to have an augmented reality application and that they wanted to receive information about augmented reality technologies.

It was concluded that the interest of gifted students in historical places increased after the augmented reality-supported teaching of historical places. In the studies conducted by Aktaş (2023) and Önal and Önal (2021), it was determined that the interest of gifted middle school students in astronomy increased as a result of the augmented reality-supported astronomy education, and in the study conducted by Yıldırım and Arıcıoğulları (2024), it was determined that the interest of middle school students in science class increased with the augmented reality applications.

As a result, it was determined that students had positive thoughts about the teaching of historical places supported by augmented reality. It was predicted that the enriched activities regarding the teaching of historical places supported by augmented reality would have positive effects on the learning process and development of specially gifted students.

Recommendations

In line with the results of the research, the following suggestions can be made; Augmented reality-supported activities can be designed for different lessons, subjects and contents, especially in teaching abstract concepts. Augmented reality technology production workshops can be created for gifted students.

Limitations of Study

This research, Limited to the 2024-2025 academic year. It is limited to 3rd grade primary school students studying at the Onikişubat Science and Art Center in the Onikişubat district of Kahramanmaraş province. Limited to the questions included in the “self-assessment form”.

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Appendix 1. PTTAR Historical Places Cards**Appendix 1/A.** 2nd Term Grand National Assembly

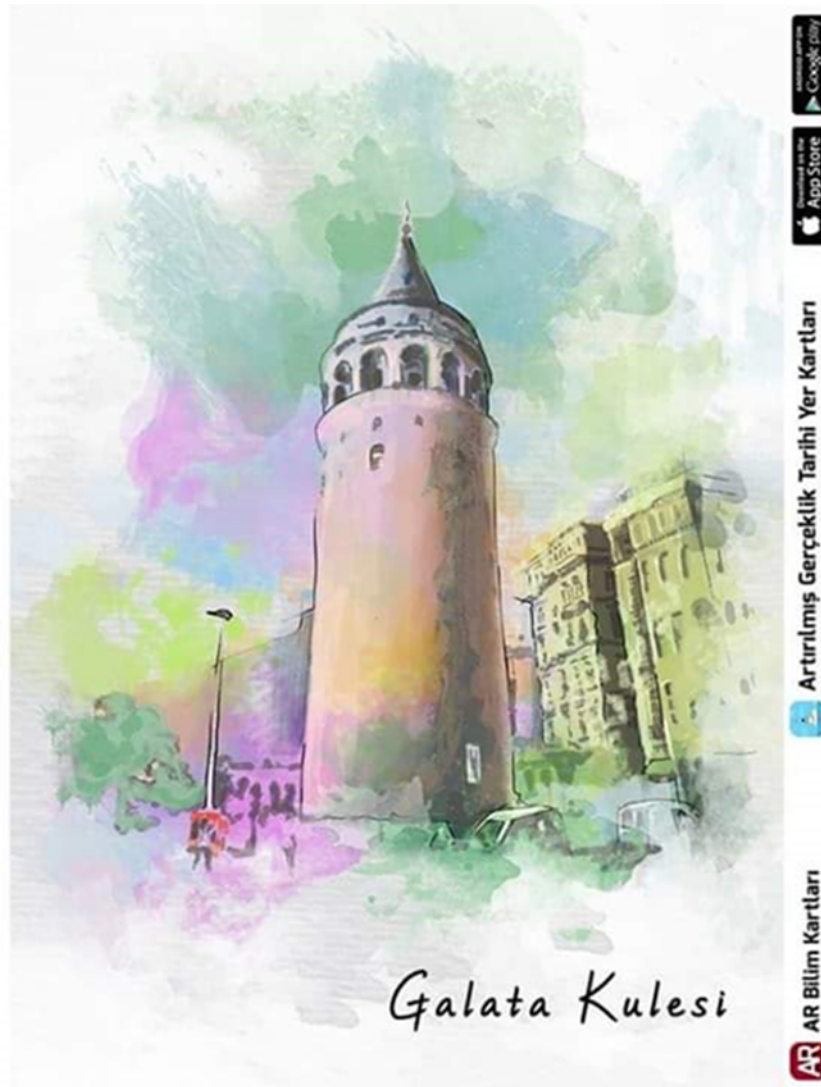
Appendix 1/B. Sultanahmet Mosque



Appendix 1/C. Bursa Grand Mosque



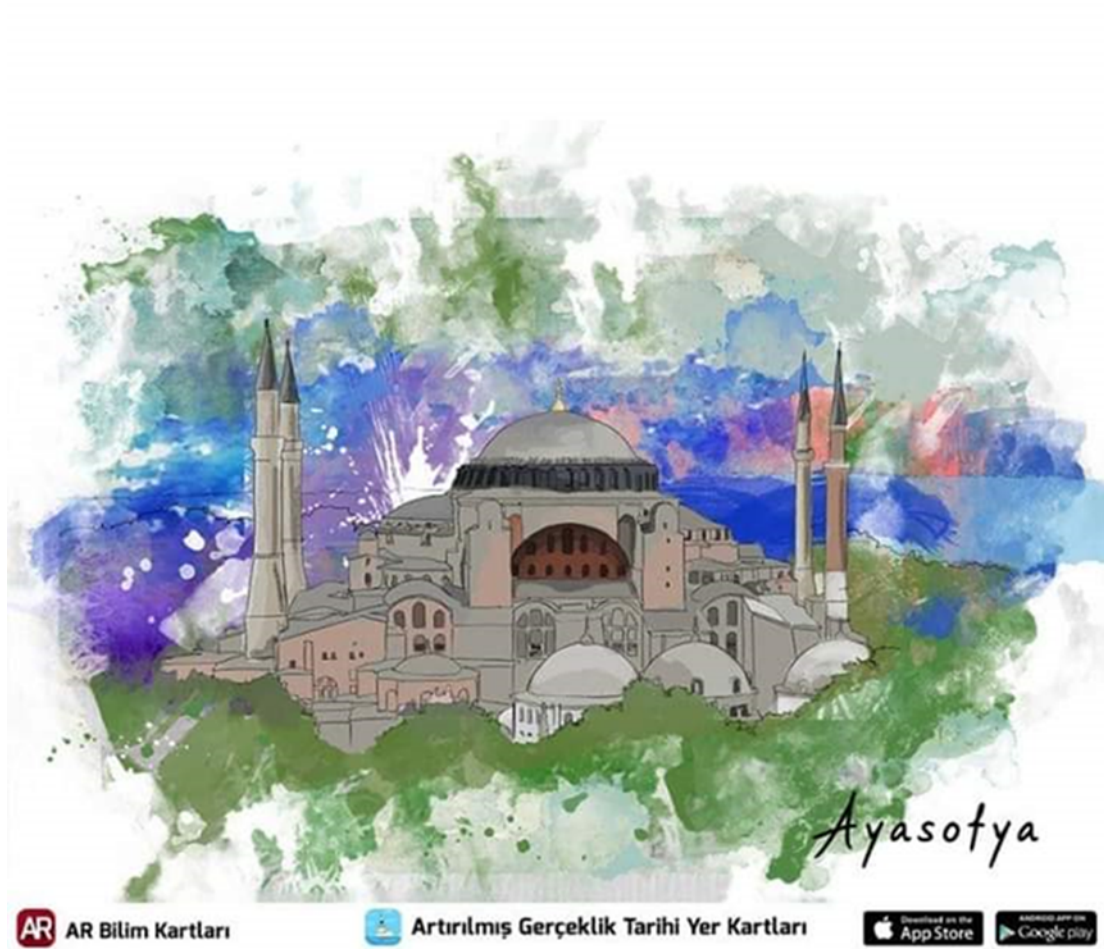
Appendix 1/D. Galata Tower



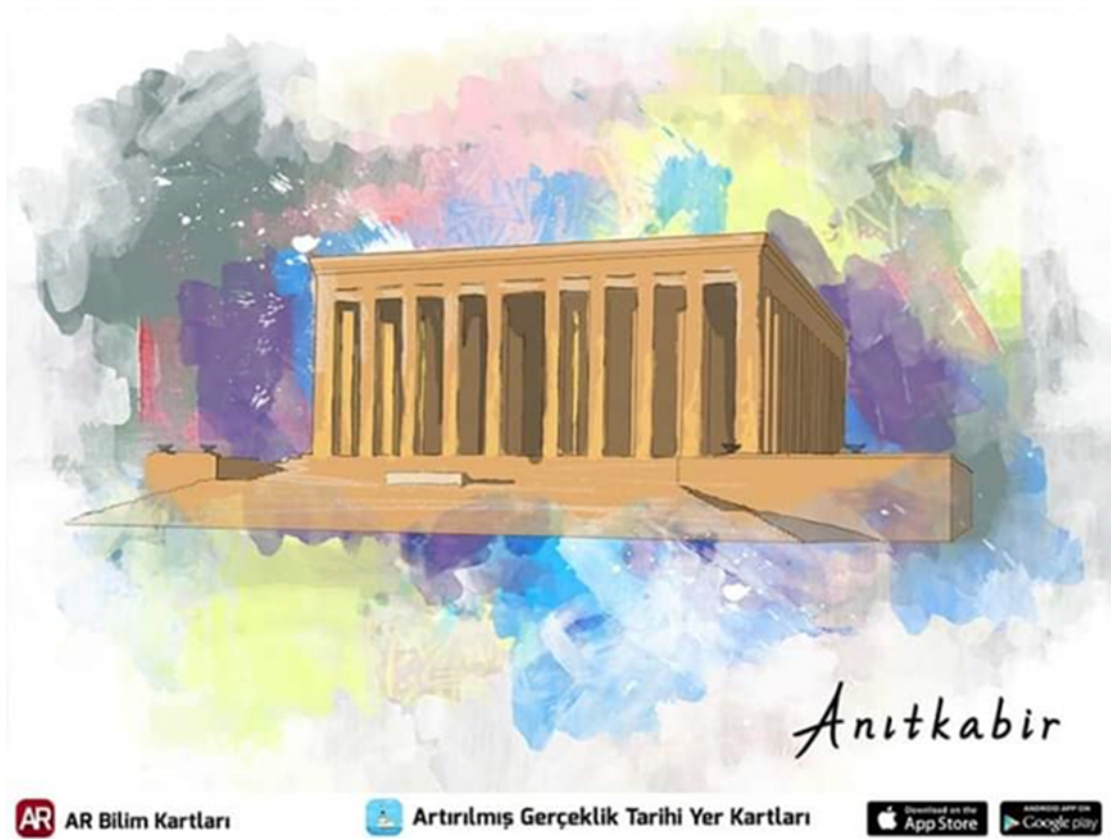
Appendix 1/E. Maiden's Tower



1/F. Hagia Sophia Mosque



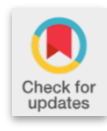
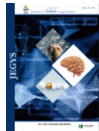
Appendix 1/G. Anıtkabir



Appendix 2. Self-Assessment Form

Self-Assessment Form
Activity name: Opinions of Specially Gifted Students on Augmented Reality-Supported Historical Places Education
Explanation: Answer the following questions by taking your own opinions into account.
Q1. What did I learn in this activity?
Q2. What did I enjoy most in this activity?
Q3. What did I find most difficult in this activity?
Q4. What is my suggestion for this activity?

Thank you



Research Article

Examination of teachers' views on the development of pre-school children's thinking skills

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Preschool education
Preschool teacher
Thinking skills

Abstract

In this study, it was aimed to reveal the views of preschool teachers on the development of children's thinking skills in preschool education and the use of philosophy with children approach in the development of children's thinking skills. In this study in which qualitative research method was used, data were collected through focus group interviews. The study group was determined using the maximum diversity sampling technique, which is one of the purposeful sampling methods. The participants of the study consisted of 40 teachers working in preschool education institutions in Antakya central district and Yayladağı district of Hatay province. Focus group interviews were conducted with 8 groups consisting of 4-10 people. In the study, a semi-structured interview form developed by the researcher with expert opinion and pilot study was used to determine the views of preschool teachers. According to the findings, teachers stated that the current preschool education program is not sufficient to develop children's thinking skills, that they need a different education to develop children's thinking skills, that children use their thinking skills mostly in storytelling/reading/creating activities, scamper activities, games and science/nature/experiment activities, and that philosophy activities with children can be effective in developing children's thinking skills. In addition, suggestions such as supporting pre-service and in-service trainings on thinking skills and philosophy education with children, conducting family participation activities with the cooperation of the family and the teacher during the education process, and organizing the preschool education program to develop thinking skills have emerged.

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Introduction

In accordance with the requirements of the age we are in, changes in education and training are taking place in the world and in our country. Depending on the conditions of the time, efforts to improve education and training aim to raise individuals who think and produce instead of rote learning and teaching culture. In the twentieth century, being autonomous, creative and critical thinking, problem solving skills, taking responsibility for one's behaviour, structuring and making sense of knowledge are important building blocks of education. The issue of thinking education in education is fundamental all over the world. Bochenski (1996) defines thinking as all the movements we make while creating our designs and concepts. Thinking can also be expressed as going beyond existing knowledge or reaching new knowledge based on existing knowledge (Saban, 2014). Polette (2005, p.2) states that thinking starts with a need, question or problem. According to him, good thinking is formed by the use of analysis, association, classification,

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comparison, understanding, evaluation, flexibility, fluency, prediction, generalisation, acting with assumptions, interpretation, planning, prediction, questioning, sorting, synthesis and more skills. As a result of good thinking, new skills, concepts, decisions, actions, discoveries, ideas, methods or new questions and needs should emerge.

Thinking skills are special cognitive processes that are accepted as the building blocks of thinking (Alkın Şahin & Tunca, 2013, p.398). Childhood is the basic period when thinking and living skills are acquired and cognitive development is at the highest level. In this period, it is necessary to focus on how to develop thinking skills. Accordingly, philosophy for children is a thinking education approach that has started to be used in the education programme. The aim of the philosophy with children approach, which focuses on group reflection on a philosophical subject and discussion of the subject by children, is for children to acquire cognitive skills for questioning processes and to develop thinking skills in this process (Pekkarakaş, 2020). Philosophy with children is not learning philosophical knowledge or reading texts; however, it can be expressed as ‘thinking education’ such as learning ways of thinking. Philosophy with children focuses on thinking and aims to develop thinking skills; in this endeavour, the secondary aim is to provide knowledge and culture of philosophy. The primary aim of philosophy with children is to develop critical, creative and attentive thinking skills. Developing decision-making and judgement skills and thus processing philosophical feelings in children are among the primary functions of this approach (Gregory, 2011).

Philosophy with children can be expressed as the method of learning through questions. In this method, unlike the classical method in which teachers give information to students ready-made, questions are seen as the key to learning. In the beginning, a discussion on a certain subject is initiated on the assumption that the person does not know anything about the subject, and it is developed step by step by establishing cause-effect relationships. The discussion is concluded with a judgement. Children are encouraged to listen to each other during the discussion, ask each other questions and share their opinions about the questions asked. The discussion is supported by the teacher by asking guiding questions, but the teacher is not in full control (Vansieleghe, 2005). The ‘Philosophy for Children (P4C)’ approach was introduced by Matthew Lipman and Ann Sharp towards the end of the 1970s and was later transformed into a thinking education programme with this name (Okur, 2008). The Philosophy Education Program for Children (PEPC) is based on children learning by asking questions, questioning and discussing in dialogue with each other. Children are generally asked to ask the questions to be discussed. Thus, children who take an active role in this process will learn to think better and ask better questions (Taş, 2017).

Matthew Lipman states that philosophical thinking begins when children start to ask questions such as ‘why?, why?’ and that this develops over time (Philgren, 2008). Children can understand philosophical concepts and answer philosophical questions from a very young age. The answer given by a three and a half year old child to the question ‘What is happiness?’ as ‘not being alone’ can serve as an example for this situation. Children enjoy beautiful things, show resistance when they think that they have been wronged (concept of justice), and make judgements about good and bad (Gregory, 2008).

Lipman founded an institute called ‘Institute for the Advancement of Philosophy for Children’ in 1974 (Kennedy, 1999). The Institute for the Advancement of Philosophy for Children stated that children should be given educational programmes on “philosophy with children” from early childhood. The reason for this is that children should be encouraged to think and make philosophical enquiries starting from early childhood. He also stated that philosophy enables children to recognise their environment and themselves, to acquire knowledge and skills, to use the knowledge and skills they have acquired, and to discover thought-provoking phenomena that exist in their daily lives (Pekkarakaş, 2020). The most important activity carried out in this institute is to show that philosophy can be done not only verbally with children, but also through various literary genres (fairy tales, stories, legends, legends, theatre), paintings, music and sports (Martens, 1994; cited in Karakaya, 2006).

Preschool education programme is carried out with activities and philosophy education can be included in these activities. The teacher can plan activities with the aim of developing philosophical attitudes and behaviours in children. An important part of philosophy activities in this age group is done with illustrated children’s books. Especially stories

with pairs of opposite or complementary concepts such as good-bad, danger-safety, accident-intention, children-adults, people-animals can have a very intriguing effect on preschool children (Kennedy, 1996).

In the light of all this information, it can be said that it is important to include the philosophy with children programme in the education of preschool children in order to raise individuals who have developed thinking skills in line with the needs of our age, have high questioning skills, can think in a multidimensional way and obtain information through their own experiences by structuring it instead of taking it ready-made. For these reasons, this study aims to reveal the opinions of preschool teachers about the development of children's thinking skills in preschool education and the use of philosophy with children approach in the development of children's thinking skills.

Method

Research Desing

In this study, qualitative research method was used to reveal the views of preschool teachers on the development of children's thinking skills in preschool education and the use of philosophy with children approach in the development of children's thinking skills. Qualitative research is a type of research that enables perceptions and events to be revealed in a realistic and holistic manner in a natural environment by using data collection techniques such as observation, interview and document analysis (Yıldırım and Şimşek 2013). In addition, in this study, data were obtained through focus group interview, which is one of the interview types of qualitative research.

Study Group

In determining the study group of this research, maximum diversity sampling, which is one of the purposeful sampling methods, was used. Purposive sampling provides in-depth study of situations that are thought to have rich information, and maximum diversity sampling provides the diversity of individuals who are parties to the problem being studied (Yıldırım & Şimşek, 2013). In order to ensure maximum diversity, during the determination of the teachers to be interviewed within the scope of the research, it was tried to pay attention to the fact that the teachers were working in different types of schools (kindergarten / independent kindergarten within the primary school), working in institutions located in different socio-economic regions, and having different educational status and length of service. Based on these criteria, the participants of the study consisted of 40 teachers working in preschool education institutions in Antakya central district and Yayladağı district of Hatay province. Focus group interviews were conducted with 8 groups consisting of 4-10 people. Teachers participated in the focus group interviews voluntarily participated in the interviews.

Demographic Characteristics of Preschool Teachers

Data on gender, age, professional experience, type of institution and educational background of preschool teachers are presented in the tables. Demographic characteristics related to the gender of the participants are given in Table 1.

Table 1. Characteristics of preschool teachers' gender

Gender	f
Woman	39
Male	1

According to Table 1, 39 of the 40 preschool teachers who participated in the study were female and 1 was male. Characteristics related to the ages of the participants are given in Table 2.

Table 2. Characteristics of preschool teachers' age range

Age Range	f
20- 30	11
30- 40	22
40 and above	7

Of the 40 preschool teachers who participated in the study, 11 were between the ages of 20-30, 22 preschool teachers were between the ages of 30-40, and 7 preschool teachers were 40 years old or older.

The characteristics of the participants' professional experience are given in Table 3.

Table 3. Characteristics of preschool teachers' professional experience

Professional Experience	f
1-10 years	19
10-20 years	16
20 years and above	5

Of the 40 preschool teachers who participated in the study, 19 had 1-10 years of professional experience, 16 had 10-20 years of professional experience, and 5 had 20 years or more of professional experience.

The characteristics of the participants' educational background are given in Table 4.

Table 4. Characteristics of educational background of preschool teachers

Education Status	f
Associate Degree	2
License	35
Master	3

Of the 40 preschool teachers who participated in the study, 2 had associate's degrees, 35 had bachelor's degrees and 3 had master's degrees.

The characteristics of the institutions where the participants work are given in Table 5.

Table 5. Characteristics of preschool teachers' type of institution

Type of Institution	f
Kindergarten	28
Kindergarten Class	8
Day Care Center	4

Of the 40 preschool teachers who participated in the study, 28 were working in kindergartens, 8 in nursery schools and 4 in day care centers.

Data Collection Tools

In the study, a semi-structured interview form consisting of five open-ended questions prepared by the researcher was used to determine the views of preschool teachers. In order to ensure internal validity in the study, the semi-structured interview form was presented to five field experts. In line with the opinions of the field experts, the questions were revised and prepared, and a pilot interview was conducted with 6 preschool teachers other than the participants. As a result of the pilot interview, necessary corrections were made and the form was finalized.

In order to collect the data, the following questions were asked to the preschool teachers respectively.

- Could you please briefly introduce yourself? Did you take a philosophy course in your undergraduate education? Did you receive any education on philosophy/ philosophy with children afterwards?
- What do you think about the preschool education program implemented in your institution in terms of developing children's thinking skills? Could you explain?
- Have you observed children in your class using thinking skills (critical, creative, attentive and collaborative) during the educational process? Can you explain by giving examples?
- Do you need a training on developing children's thinking skills in preschool education and why?
- What are your ideas about the contribution of a philosophy education for preschool children to the development of children's thinking skills? Could you explain?

Data Collection

The data of the research were obtained by focus group interview. Focus group interview is an interview technique that enables to reveal the thoughts and ideas on a certain subject in detail and to obtain richer information with small groups of people with similar characteristics (Berg, 2001; Yıldırım & Şimşek, 2013). In the research, focus group interview was preferred in order for the pre-service teachers to express themselves more comfortably in a group environment without feeling that they were being interrogated.

The interviews were conducted in the institutions where the participants were working, taking into account the days and hours they were available. At the beginning of the interview, preschool teachers were informed about the study and the purpose of the study. After the approval of the teachers for participation in the interview was obtained once again, the interview was conducted by the researcher. Focus group interviews were conducted with 8 groups consisting of 4-10 people. The interviews lasted between 35-55 minutes.

Data Analysis

The data obtained as a result of the research were analysed using content analysis, one of the qualitative data analysis techniques. Firstly, the interview data were transcribed without making any changes on the interview data. The transcribed data were analysed by two researchers. The prominent aspects of the analysed data were determined and codes and then themes were formed. Then, the codes and themes created separately by both researchers were compared and the codes and themes were clarified. The data were grouped under seven main themes. These were determined as “the training that preschool teachers received on philosophy, the effect of the preschool education program on children’s thinking skills, the situations in which children use their thinking skills during the education process, the need for training to develop children’s thinking skills in preschool education, and the contribution of philosophy education for preschool children to the development of children’s thinking skills”. In order to effectively reflect the views of the teachers who participated in the focus group interviews, the findings obtained in the research were supported by direct quotations. However, in the sample quotations, only a few of the teachers’ expressions that expressed exactly the same opinion and included similar expressions were included. In order to ensure that the participants answered the questions sincerely, it was stated that their names would not be mentioned and codes (T1, T2, T3...) were used.

Validity and Reliability

In order to ensure the validity of the data collection and analysis processes, attention was paid to ensure that the collected data were consistent and meaningful within themselves. In this direction, the consistency between the purpose of the study, data collection tool and data analysis was taken into consideration. The data collection tools used in the study were prepared based on the literature review, presented to expert opinions and tested in trial interviews. In addition, in order to increase the validity and reliability in data analysis, both coding and determining the themes were done by two researchers separately and compared. The reliability formula determined by Miles and Huberman (1994) was used to determine the consensus between the researchers. The consistency of the researchers’ coding of the themes was calculated as 0.86 on average. The fact that this result exceeds 0.70 (Miles and Huberman, 1994: 64) shows that the coding is reliable. In addition, in order to ensure validity and reliability, the statements reflecting the views of the participants were included in the findings section in the form of direct quotations and by specifying the codes of the participants.

Results

In this section, the findings and interpretations obtained from the focus group interviews conducted to reveal the views of preschool teachers on the development of children’s thinking skills in preschool education and the use of philosophy with children approach in the development of children’s thinking skills are presented. As a result of the analyses, the findings were grouped under seven main themes. These were determined as ‘the training that preschool teachers received on philosophy, the effect of the preschool education programme on children’s thinking skills, the situations in which children use their thinking skills during the education process, the need for training to develop children’s thinking skills in preschool education, and the contribution of philosophy education for preschool children to the development of children’s thinking skills’.

Preschool Teachers' Training on Philosophy

The trainings that 40 preschool teachers participating in the study received on philosophy and philosophy with children during and after their university education were determined and the distribution shown in Table 6 was formed.

Table 6. Distribution of teachers who received education on Philosophy

Teachers' philosophy education	f
Teachers receiving in-service training on philosophy with children	2
Teachers taking philosophy with children course in undergraduate education	1
Teachers doing academic work on philosophy with children	1
Teachers who have knowledge about philosophy with children	3
Teachers taking philosophy of education course in undergraduate education	13
Teachers who have not received any training	11

When Table 6 was analysed, it was seen that most of the participants did not receive a detailed education on philosophy. However, one participant stated that they took a course on philosophy with children during their undergraduate education and two participants stated that they received in-service training on philosophy with children. One participant stated that he had received thinking training during his master's degree and did his graduation project on philosophy with children. Three of the participants stated that they did not receive education on philosophy with children, but they had knowledge about it. Some of the participants stated that they only took the philosophy of education course during their undergraduate education.

T25, one of the preschool teachers, related to the 'philosophy with children' course they took during their university education: *"When I was in undergraduate education, we had an elective course called philosophy with children. I mean, you know the scamper technique. It was that kind of education. Children were asked questions like 'what would happen if this did not happen?'. We had a one-semester training on how to expand this and spread it to the lesson".* One of the teachers, T5, also expressed what he knew about philosophy with children as follows; *"I went to in-service training seminars in 2010. Philosophy education in pre-school was explained to us there. Children gain the ability to think from different perspectives. Yes. For example, when telling the story of Little Red Riding Hood, why is the wolf related to the grandmother? Is he very hungry? Or when telling the story of the golden-haired girl and the 3 bears, can the 3 bears help the girl? Or should the girl run away scared? The aim is to question from many angles."* Ö31 also described his education and experience on philosophy with children by saying *"In my master's degree education, we took a course on thinking education. Within the scope of that course, we examined the philosophy approach with children. I did my graduation project on philosophy with children. In this context, we did philosophical activities with 3-4 children"*.

Preschool Teachers' Opinions on the Effect of Preschool Education Programme on Children's Thinking Skills

The opinions of preschool teachers on the effect of the preschool education programme implemented in their institutions on the development of children's thinking skills are presented below.

Table 7. Preschool education programme's improvement of children's thinking skills

Qualifatication of program	f
Develops / sufficient	11
Developing but not enough	29

When Table 7 is examined, 11 of the participants were of the opinion that the preschool education program improved thinking skills and was sufficient, while 29 participants were of the opinion that it improved but was not sufficient. It was understood that the participants in general had positive effects on the development of children's thinking skills in the current program, but not enough. A significant portion of the participants stated that thinking

skills are included in the preschool education program in use, but that they remain in the background in practice. T11, one of the preschool teachers who thinks that the curriculum they implement develops children's thinking skills sufficiently, said *"It is a flexible programme, a child-centred programme. I mean, I think it is more related to the teacher's organisation in the classroom, that is, his/her approach to the child. We give them the opportunity to question. For example, by asking them questions after a story activity, we try to develop their thinking skills and enable them to express themselves"*. Similarly, T15 said *"The programme allows us to do this because it is flexible and child-centred. And there is interactive book reading in the programme. When we use it, I think we can ask questions for questioning"*. T12 said *"It is sufficient, especially in creative thinking. For example, there are no mould colourings like before. We give the child a blank paper, give them a theme and tell them to draw as they like and paint in any colour they like. For example, in our childhood, the tree used to be green. We don't tell children that now. Trees can be any colour if you want"*.

Most of the participants stated that the current programme had positive effects on the development of children's thinking skills, but it was not sufficient. In relation to this, T27 said, *"I don't think it is very clear and precise. I think we prioritised different things. This kind of thinking is in the background. We improve them more academically or motorically and physically. We think that we should prepare them directly for the first grade. I mean, I don't think it is very effective"*, while T19 stated that *"There are no achievements and indicators in the programme that will lead to thinking. I think that our achievements are insufficient in this age. It says that it recognises between one and five. The child already recognises it when he/she comes to school. He counts up to 100. The child says, 'You opened baby things to us'. Actually, the programme needs to be taken to a higher level. I think this should not happen in pre-school"*. T7 said, *"When we look at the gains, we can see traces of them. But how much? It can be indirect, not precise. But it is a little bit up to the teacher. For example, it says to interpret a work of art, but I can interpret it straightforwardly. But if the teacher has the capacity with creative thinking skills, if he wants to look in that direction, if his perception is in that way, the teacher directs in that direction. But it is mostly fashion mode education"*.

Preschool Teachers' Views on the Situations in which Children Use Thinking Skills in the Education Process

Preschool teachers' views on the situations in which children use thinking skills in the educational process are presented below.

Table 8. Situations in which children used their thinking skills in the preschool education process

Using thinking skills	f
Free time activities	4
Play activities	5
Story reading/creating activities	8
Drama activities	3
Science/nature/experiment activities	5
Art events	4
Conversational activities based on an event/situation/image	4
Scamper activities	5
Robotic coding activities	2
Evaluations made at the end of the event	4
Group activities	3
Classroom organisation times	2
Daily routines	2

When Table 8 is analysed, it is seen that children use thinking skills in different situations within the daily education flow. It was determined that preschool teachers observed that children mostly used thinking skills during activity times. In addition, preschool teachers stated that children used their thinking skills more in activities based on storytelling/reading/creating among activity types. Afterwards, it is seen that scamper activities, play activities and science/nature/experiment activities are among the activities in which children use their thinking skills. Eight of the participants stated that they demonstrated the gains related to children's thinking skills in story reading/telling/creating activities. One of these participants T33 expressed his views as follows: *"I try to catch this in book activities the most. For*

example, we read a story. What could you do if you were in that story? You know, I generally prefer these questions more in story reading. Or I want them to empathise by asking questions. Or how could this event have happened? For example, if it ended negatively, how do you think we could make a positive? If you were in his place, could you make this mistake? Or how could we behave? I try to ask all of these questions in the story, more or less". Similarly, T7 said, "I usually apply critical thinking in story time. How do I apply it? First I tell the story, then I go back to the beginning, I show the pictures again. For example, today we had Meryat, a girl with red hair. There were hairstyles there. First I told my story, without going into too much detail. I went back to the beginning and continued by taking their comments. Such activities are a little more comfortable during story time." T38 said, "There are story cards. The children create their own stories by looking at their pictures" and stated the importance of story creation activities.

One of the participants T21 "I think that I addressed more thinking skills with the Scamper study, because when I say something in the child's imagination or when I tell him something that is not there, there is a thinking in the child. And then the child can give me an answer. Otherwise, I cannot get feedback, sometimes not even with the way the plan is implemented. However, I can get children's thoughts with something in their imagination or, as I said, with the scamper study. for example, what did we do? What would happen if a fish had a nose? I mean, when I say that, I know that the children respond in unison and they can tell you what they think".

T27, one of the participants, said "They usually play group games. If they are going to play a car game, someone builds the garage, someone repairs the road. It usually proceeds in a collaborative way." and stated the effect of group games on collaborative thinking skills. T17 also made a similarly supportive explanation by saying "I can give an example in collaborative learning. When you pair children who have difficulty in participating in the activity at first with children who can do it very easily, we both support the child who has difficulty through peer learning and provide collaborative learning'. One of the participants, T23 said, 'They develop their imagination very well with play dough. We have a conversation about what they do. As soon as I give them play dough, I really reveal their imagination worlds directly', he stated the importance of play activities and play materials. T36 also stated 'Block centre. They make shapes by using their creativity so well. They make very different shapes' and explained the effect of both play materials, leisure time activities and learning centres on creative thinking.

T22 "I always feel like they think more in experiments. I mean, how will the end be? How will the beginning be? Comparing two experiments. I feel like they think more in these activities compared to other activities" and stated the effect of science/experiment activities on thinking skills. T35 said, "I created a playground for us outside under the pine trees. For example, the children made paintings with the flowers they collected from nature. This activity contributed to children's creative thinking skills. In that area, yes, they developed their thinking skills in an integrated way with art by observing nature. Discovering nature and thinking creatively about it" and stated that nature and art integrated activities developed creative thinking skills. Regarding the art activity, T18 said, "For example, once we were not going to use paper anymore in the art activity. He took the leftover paper from the floor. He added a moustache to the activity he did. This shows creative thinking" and made a supportive statement.

One of the participants T33 "I showed a picture the other day. What do you think is described in this picture? There was a hedgehog and the hedgehog had thorns. Someone said, "It has thorns like a rose. Let's not touch it. Someone said that he protected himself so that he wouldn't get hurt. Very different thoughts come out and we cannot think like them in the adult mentality. I think they look at it from very different angles." He stated the effect of conversation activities on visuals on children's development of different thoughts.

Preschool Teachers' Opinions on the Need for Training to Develop Children's Thinking Skills in Preschool Education

Preschool teachers' views on the need for training to develop children's thinking skills in preschool education are presented below.

Table 9. Training needs for developing children's thinking skills in preschool education

Necessity of training	f
Training is needed	40

According to Table 9, 40 preschool teachers who participated in the study stated that they needed a different kind of training to develop children's thinking skills in preschool education. One of the participants T38 said *"It is necessary. He cannot express himself, he does not say what he thinks. He is withdrawn in himself. He is curious, but how do I express him? How do I ask? We get stuck at the point"* and stated the reasons for the need in the field. T3 also said *"There should be, but it should be in small groups. In groups of 5-6 people separately. It affects children more easily and faster. In other words, it should be for children in this age group to think differently, or to develop the ability to be in a group with each other, for self-confidence, for example, developing these thinking skills also develops the child's sense of self-confidence. Children who think differently can satisfy themselves more easily. Or, for example, a child who thinks collaboratively can adapt to the group more easily. For example, we currently have difficulty in the adaptation of some of our children. That's why we use it in all areas of life and we need it"* and stated that there is a need for such a training but it should be done in small groups. T8 said *"We need it. But I think it would probably be easier to implement if it was a little more prominent or if teachers were provided with a little more practical opportunity about the techniques of how to apply them. We get stuck in the thing, teacher. For example, the child answers. He says I liken it to a cloud. After that cloud, the teacher also gets stuck, wondering how to continue after such a point."* and stated that there is a need, but teachers should be supported in this regard.

One of the participants T26 *"I think it may be necessary as an extracurricular activity. Because children are always between home and school to get out of the building a little bit. Natural environment, such as forest schools, is very nice, so it can be an alternative thing in addition to our plan or programme like his"* and stated that it would be a more suitable education for children's needs by combining it with education in nature. Some of the participants also stated that education for children would be more effective when supported by family education. This view was expressed by T30: *"Thinking skills. It should be started immediately. Even before that, all parents should be given this training. Children's education should start at home"*.

Preschool Teachers' Opinions on the Effect of Philosophy Education with Children on Thinking Skills of Preschool Children

The views of preschool teachers on the effect of philosophy education with children on preschool children's thinking skills are presented below. Most of the participants stated that philosophy activities with children can be carried out in order to develop thinking skills of preschool children and that it would be useful. However, some participants expressed concern that philosophical activities may remain abstract for preschool children.

Table 10. The effect of philosophy education with children on thinking skills of preschool children

Effect of philosophy education for thinking skills	f
Provides multidimensional thinking. /Provides creative, critical, co-operative and attentive thinking.	11
Provides a different point of view.	8
Develops the ability to enquiry.	6
It enables different questions to be asked.	2
Develops the sense of curiosity.	4
It provides a transition from moulded thoughts to a freer thought structure.	4
It enables them to form their own value judgements.	3
It allows him to express his thoughts more comfortably.	3
Develops listening skills.	1
Self-confidence and self-esteem develops.	2
The ability to empathise, value and respect the opinions of others develops.	1
Develops the ability to change one's mind and to agree with the ideas of others.	1

According to Table 10, the participants expressed their opinions especially on the development of multidimensional thinking, creative critical, collaborative and attentive thinking, having different perspectives and questioning skills. T37 one of the participants said *"He will start to look at something in many ways. In other words, when I give something stereotyped as a teacher, maybe he/she will not take it. He will first question it with me"*, while T38 said, *"He will do brain*

gymnastics. Yes. He will think creatively. He will think more critically. Without fitting that mould in his/her head. Or maybe not. Maybe he will convince me that this is not the case". T12 also expressed similar views by saying *"I think that it will support critical and questioning skills, so that the child will not continue his/her life as a single mould, he/she can look for a very good door".*

One of the participants T29 *"When the child grows up in the future, he/she will have his/her own unique idea and thought structure. He will be able to express this. He will be able to express his thoughts more easily"* and stated that philosophy activities with children can be effective in the formation of children's own thought structure and their ability to express them. T34 said, *"We will give him the right to speak or listen to his questions. We will answer their questions. When we give an answer, he will ask a question. Because of this, listening skills will also improve. Thinking that someone is listening to me, someone values me, someone is curious about my thoughts. Firstly, they will be able to learn self-respect and love, and then they will be able to learn respect and love for others."* He stated that philosophy activities with children would develop children's skills of expressing their thoughts, asking questions and listening skills, and would also develop children's skills of love and respect for themselves and others. T30 stated that philosophy with children activities can be effective in many areas of children's education by saying *"Philosophy with children activities can contribute to all subjects, self-confidence, collaborative solidarity, thoughts about life, mathematics education, science and nature activities".*

Conclusion and Discussion

In this study, teachers' views on the development of thinking skills of preschool children were analysed. In the study, firstly, the training that preschool teachers received on philosophy and philosophy with children was examined. However, it was observed that most of the participants did not receive a detailed training on philosophy. It is seen that one participant received philosophy with children education at the undergraduate level, one participant at the graduate level and two participants received philosophy with children education as in-service training. In general, the education on philosophy that the participants received during their university education was limited to the philosophy of education course. However, some of the participants stated that the education they received was insufficient in the face of the educational needs of the 21st century and that they should be supported by the Ministry of National Education with practical training on philosophy and thinking skills with children. In the study conducted by Kodaz et al. (2023) with teachers, teachers suggested that the thinking education course should be included in the programme, that the Ministry should provide philosophy training for children, and that philosophy for children should be included in the programme as a field. In their study, Çelebi et al. (2022) mentioned the importance of philosophy for children in terms of developing thinking skills and suggested in-service trainings for teachers. In this respect, it is seen that Kodaz et al. (2023) and Çelebi et al. (2022) and the teachers participating in this study have similar views.

Within the scope of the second theme of the research, preschool teachers' opinions on the effect of the preschool education programme on the development of children's thinking skills were examined. The participants generally stated that the programme has positive effects on the development of children's thinking skills, but it is not sufficient. In the study of Akbıyık and Kalkan Ay (2014), as a result of the opinions of preschool administrators and teachers, it was concluded that there is no programmed and systematic training for the development of thinking skills in preschool education institutions. In the study conducted by Akbaba and Kaya (2015) with teachers, it was stated that thinking skills in children can be developed through education, but thinking skills education/teaching in preschool education institutions is not included in the education programme and teachers are not adequately equipped in this context. These studies support the findings of this study.

In the third theme of the study, preschool teachers' views on the situations in which children use thinking skills in the educational process were analysed. It was determined that preschool teachers observed that children mostly used their thinking skills during activity times. In addition, preschool teachers stated that among the types of activities, storytelling/reading/creation-based activities and then scamper activities, play activities and science/nature/experiment activities are among the activities in which children use their thinking skills. Taggard et al. (2005) stated in their study that story hours are important for developing children's thinking skills. Yazıcı et al. (2019) also revealed the effect of

story-based activities on the creativity skills of 61-66-month-old children attending kindergarten. Doğan Altun and Ekinci Vural (2017) stated in their study that preschool teachers should include activities such as games, drama, and travel and observation activities that encourage student-centred questions to gain thinking skills. These studies support the findings of this study.

In the fourth theme of the study, preschool teachers' views on the need for training to develop children's thinking skills in preschool education were analysed. All of the preschool teachers who participated in the study stated that they needed a different training to develop children's thinking skills in preschool education. Preschool teachers stated that there is a need for such a training for reasons such as children's ability to think differently, express their thoughts more easily, ask different questions, develop self-confidence, and adapt to the group with cooperative behaviours. Lipman stated that thinking should be taught at an early age. According to Lipman, by starting to provide thinking education at an early age, children will be given the necessary tools in terms of both knowledge and moral and personality development such as questioning, criticising, proposing alternatives, approaching with scepticism, testing accuracy and consistency at an early age (Lipman et al., ed. 2023). Okur (2008), as a result of his study on philosophy for children, which he conducted with five-six year old children, stated that there were differentiations in children's ability to act individually and form original sentences with thinking education. These statements are similar to the results of this study.

In the fifth theme of the study, the views of preschool teachers on the effect of philosophy education with children on the thinking skills of preschool children were analysed. Most of the participants stated that philosophy activities with children can be carried out in order to develop thinking skills of preschool children and that it would be useful. However, some participants expressed their concern that philosophical activities may remain abstract for preschool children. Participants mostly stated that philosophy activities with children can be effective on the development of multidimensional thinking, creative, critical, collaborative and attentive thinking, having different perspectives and questioning skills. The themes of 'Gaining a Different Perspective', 'Developing Emotions and Thoughts', and 'Questioning/ Research/ Thinking Skills' identified by Yazıcıoğlu (2023) in his study with pre-service preschool teachers regarding the contributions of philosophy with children practices for preschool children overlap with the results of this study. Fisher (2008) examined the effect of the philosophy with children approach on children's thinking skills in terms of questioning (investigating the question, discovering the problems in the questioning process, learning how to examine, ask, describe), reasoning, organising information, making sense, concept structuring (defining, classifying, conceptual connections and frameworks), reasoning (logic, argumentation, inductive and deductive reasoning/critical thinking), inferring meaning and establishing relationships between meanings, problem solving and translation skills (interpretation, understanding, establishing relationships between meanings). In Çayır's (2015) study, it was observed that students developed different perspectives on events and situations and developed the ability to look at more than one dimension. In Ögüt's (2019) study, it was concluded that philosophy education activities with children improve students' questioning and thinking skills. These statements support the results of the study.

Recommendations

In the view of the results obtained in the study, the following suggestions can be made:

- Pre-service and in-service trainings on thinking skills and philosophy education with children can be supported for teachers who are important guides in the development of thinking skills.
- Pre-school education programme can be designed to develop thinking skills. It can be integrated with philosophy education approach with children.
- In the education process, family participation activities can be emphasised with the cooperation of the family and the teacher, families and teachers can be brought together to ensure that they are also effective in practices aimed at developing thinking skills, and it can be ensured that they contribute to the process with workshop practices related to Philosophy with Communities (P4C).

- The educational environment can be organised in a way that contributes to the development of children's thinking skills.
- Pre-service teachers can be supported with courses and practices that will increase the equipment of the faculties of education that train pre-service preschool teachers in this field.
- The Ministry of National Education can prepare sample booklets and provide material support for teachers on the development of thinking skills and philosophy education with children.

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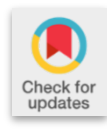
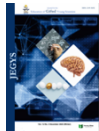


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Research Article

Mathematically precocious children in early childhood: A systematic review

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Abstract

The study examined 15 articles published in Turkish or English over the past 10 years, focusing on mathematically precocious children in early childhood in Türkiye and the international literature. The results revealed that most studies were conducted in Türkiye and were predominantly published in journals related to education and giftedness, frequently indexed in SSCI and Scopus. An analysis of the methodological aspects showed that quantitative methods were predominantly used, followed by qualitative methods. In terms of study groups, most research focused on primary school-aged children. Regarding the scope of mathematics, the studies generally addressed content and process standards in mathematics. Although the findings reflect efforts in both Türkiye and around the world to identify mathematically advanced children in early childhood and to provide appropriate educational support, it appears that the mathematical concepts addressed in the studies and the factors influencing mathematical ability are somewhat limited. In this regard, it is recommended that ministries of education and universities in various countries collaborate on projects and programs specifically designed for all children in early childhood. Such collaboration should adopt an inclusive approach, focusing on discovering children's knowledge, skills, and abilities at an early stage, and ensure coherence between the goals of different levels of the education system. Based on these aligned goals, the education of mathematically gifted children can be more effectively planned.

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Introduction

Studies focusing on high potential in mathematics began to emerge in the early 20th century with the development of the first intelligence tests. This development was further accelerated by nations and institutions recognising the importance of nurturing talent in mathematics and science in global economic and political competition (Özdemir et al., 2024). Since the 1960s, numerous influential research projects, such as The Study of Mathematically Precocious Youth (SMPY), have focused on high potential in mathematics (Lubinski, 2016; Stanley, 1996). Notably, the works of Krutetskii and Stanley have been groundbreaking in the field of mathematics education. Krutetskii, a Soviet researcher, conducted longitudinal studies on children aged 6 to 17 with mathematical talent to identify the characteristics required for high mathematical ability. His research provided valuable insights into the structure of the mathematical mind (Leikin, 2021; Lubinski, 2016).

Similarly, Stanley's work, beginning with the SMPY program in the 1970s, involved longitudinally tracking mathematically advanced students from the age of 13. His research aimed to uncover their needs, developmental

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characteristics, and the role of education in fostering talent development (Lubinski & Benbow, 2006; Lubinski et al., 2023). Following these studies, significant efforts were made in the United States to support mathematically precocious children in early childhood. Under the U.S. Department of Education's Javits Grant, the Mentoring Mathematical Minds (M^3) project was launched in 2002 for students in 3rd-5th grades (Gavin et al., 2007). The success of this project led to the development of the M^2 project, which focused on designing research-based practices for children at the K-2 level across three distinct levels of units, utilising standards for early childhood mathematics education (Gavin et al., 2013).

In all these studies on the education of mathematically precocious children in early childhood, terms such as mathematically gifted (e.g., Lubinski & Humphreys, 1990; Sowell et al., 1990; Sriraman, 2003), mathematically talented (e.g., Stanley et al., 1974), and mathematically precocious (e.g., Benbow, 1986; Lubinski & Benbow, 2006; Stanley, 1996) have been utilised. By the 2000s, one of the world's leading authorities on mathematics, the National Council of Teachers of Mathematics (NCTM) in the United States, adopted the term Exceptional Mathematical Promise (EMP) in its reports. This term emphasises not only those with mathematical talent but also individuals with a higher level of interest and engagement in mathematics (NCTM, 2016).

It can be argued that the evolution of these terms, from past to present, reflects a shift from a traditional performance-based understanding of giftedness to a more culturally specific, contextual, and dynamic conception of giftedness (Desmet et al., 2020; Jarvis & Henderson, 2015). This contextual and multifaceted structure makes identifying young children challenging and sometimes even impossible (Dai & Chen, 2013). This complexity further complicates the naming of high ability in the more specific domain of mathematics. Within this context, the term EMP has been

adopted throughout the study as a more inclusive expression for children with higher mathematical potential than their peers.

EMP in Early Childhood

Specifically, in the context of preschool children, identifying those who demonstrate EMP is complicated, with a significant portion remaining formally unidentified. As a result, such children may lack labels such as "mathematically gifted" or "mathematically precocious children" (Davis, 2012). However, Mingus and Grassl (1999) argued that exceptional mathematical ability is innate and that individuals possessing such abilities are highly motivated to work and demonstrate high creativity. The innate mathematical abilities they identified include extracting and working with the structure of a mathematical problem from its context, generalising and questioning, flexibly transitioning between approaches, working with symbols and spatial concepts, quickly recognising similarities, differences, and patterns, visualising and interpreting relationships, and ensuring simplicity, efficiency, clarity, and logic when making assertions. NCTM (2016) emphasised that while mathematical abilities may not inherently exist from birth, certain innate traits can evolve into EMP through development, effort, and provided experiences.

As gifted children progress into primary school, their interest and abilities in mathematics become more pronounced compared to their peers. Teachers report observing distinct characteristics such as varying speeds of mathematical learning, intuitive mathematical problem-solving, intense interest in mathematics, a sense of humour, the ability to think in more abstract terms than their peers, greater mental flexibility, and logical reasoning in their discourse (Assmus & Fritzlar, 2022; Bicknell, 2008; Bulut et al., 2020; Copley, 2000; Nolte, 2012; Onoshakpokaiye, 2023). Additionally, these children often exhibit persistence and enthusiasm when faced with mathematical challenges, achieve success in math-related competitions, demonstrate rapid calculation skills, excel in problem-solving, and show the capacity to independently undertake "special projects" or additional/different tasks (Subotnik et al., 2012; Waxman et al., 1996). It is well-documented that the early identification of such children and providing education tailored to their needs are persistent issues (Adedoyin & Chisiyanwa, 2018; Assmus & Fritzlar, 2022; Er, Dinç Artut & Bal, 2023).

Literature Review

When examining studies conducted globally, it has been found that most research and highly cited publications originate from the United States (Bilgiç & Baloğlu, 2023; Özdemir et al., 2024). The participants in these studies predominantly consist of students in primary school and higher educational levels (Erdem, 2023; Kaya, 2021; Sowell, 1993; Özdemir et

al., 2024). Additionally, studies focusing on the cognitive and neurocognitive characteristics of mathematically gifted students have gained prominence (Myers et al., 2017; Zhang et al., 2017). Research targeting gifted students in mathematics education has also increased over the years (Erdem, 2023; Sowell, 1993). However, it has also been observed that since 2015, there has been a declining trend in the number of studies related to EMP (Özdemir et al., 2024).

The significance of the early childhood years has been widely recognised by international authorities for over two decades (National Scientific Council on the Developing Child, 2007; OECD, 2006). Research on brain functioning and the importance of early brain development has highlighted the long-term benefits of investing in early childhood education and schooling. These studies have also revealed strong links between early literacy and mathematical development in young children (Adams et al., 2021; Claessens & Engel, 2013).

Considering that children are born with the potential to learn mathematics (Clements & Sarama, 2009), they begin to acquire mathematical concepts through various daily activities. While learning these concepts, children simultaneously develop critical thinking, problem-solving, logical reasoning, and creative thinking skills through their engagement in meaningful experiences (National Research Council, 2001). Thus, from an early age, children begin to use mathematics in their daily lives, gain social acceptance, and enhance their academic competencies in school (Akman et al., 2000).

Indeed, it is widely accepted that access to high-quality early mathematics education from a very young age creates a significant difference in children's future mathematical achievement (Geary et al., 2018; Samuelsson, 2011). Moreover, research has shown that this early achievement in mathematics can predict not only later academic success but also future career outcomes (Barnes & Raghobar, 2017; Claessens & Engel, 2013; National Research Council, 2001; Young-Loveridge, 2004; Watts et al., 2014).

In addition, children's early experiences with mathematics play a critical role in shaping their attitudes—such as curiosity, enjoyment, willingness to engage, and absence of prejudice—toward the subject (Henniger, 1987; Friedler et al., 2002). The importance of offering high-quality, well-planned, and developmentally appropriate mathematics education at an early age is underscored by the need to support children's cognitive development, which is shaped by age, maturation, and experience, and to maximize the use of their knowledge, skills, and abilities (Moses & Cobb, 2001; Nasir, 2016).

Numerous studies have also revealed that children from low-income families often struggle with mathematics (Fryer & Levitt, 2004; Sarama & Clements, 2008; Starkey, Klein & Wakely, 2004; Swafford & Kilpatrick, 2002). For many years, it has been known that factors associated with socioeconomic status—including poverty, rural residence, ethnicity, gender, language, culture, and race—affect mathematical achievement (Civil & Andrade, 2003; Civil, 2007; Lara-Cinisomo et al., 2004; Nasir, 2016; Valero et al., 2015). Therefore, in early childhood, identifying and supporting children's mathematical competencies—particularly those of children who show high potential in mathematics—is essential in terms of serving the 'best interest of the child'

When examining the body of research on mathematically gifted children (EMP), it becomes evident that studies focusing specifically on the early childhood period are relatively scarce. Therefore, the primary aim of this study is to systematically review the global research conducted on EMP children in early childhood. Conducting systematic reviews of studies on EMP children at regular intervals (e.g., every ten years) is crucial for identifying the current state of research in the field, predicting future trends, and providing insights into the recent literature for new researchers (Ulutaş & Ubuz, 2008; Paez, 2017). Particularly during the first eight years of life—when children's development is most rapid—periodic reviews of studies aimed at supporting the development and education of EMP children would be valuable. Such reviews can offer insights into the programs implemented, the challenges encountered, and the experiences of families and teachers, who are the primary supporters of these children, thereby contributing to future planning and recommendations.

Aim/Problem of the Study

By compiling research on EMP children, this study aims to compare these studies in terms of objectives, methodologies, and findings, synthesise the results, and thus provide detailed guidance for future researchers. This

study seeks to address the following research questions regarding children demonstrating Exceptional Mathematical Promise (EMP) in early childhood globally, based on studies conducted between 2013 and 2023:

- In which countries and in what types of journals indexed in which databases were the studies conducted?
- What research methods were employed in these studies?
- In which educational institutions were the studies carried out?
- What topics, concepts, or themes were addressed in these studies?
- What types of measurement tools were used in these studies?

Method

Research Model

This study employed a systematic review method. Systematic reviews meticulously evaluate relevant publications comprehensively and step by step within predefined criteria to answer a specific research question, providing a general framework (Bettany-Saltikov & McSherry, 2024; Higgins & Green, 2008; Karaçam, 2013). In this context, studies conducted between 2013 and 2023 on EMP children in early childhood in Türkiye and worldwide were analysed using descriptive content analysis, aiming to determine the general related trends. This method was chosen as the study aims to guide researchers planning to work in this field.

Stages of a Systematic Review

Various steps must be followed in systematic review studies, from defining the purpose to presenting the study. These steps include determining the purpose, selecting studies based on specific criteria, identifying the main characteristics of the selected studies, and drawing conclusions from the findings (Millar, 2004). In preparing this study, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Statement (PRISMA) was utilised to report systematic review and meta-analysis studies (The PRISMA Statement, 2020).

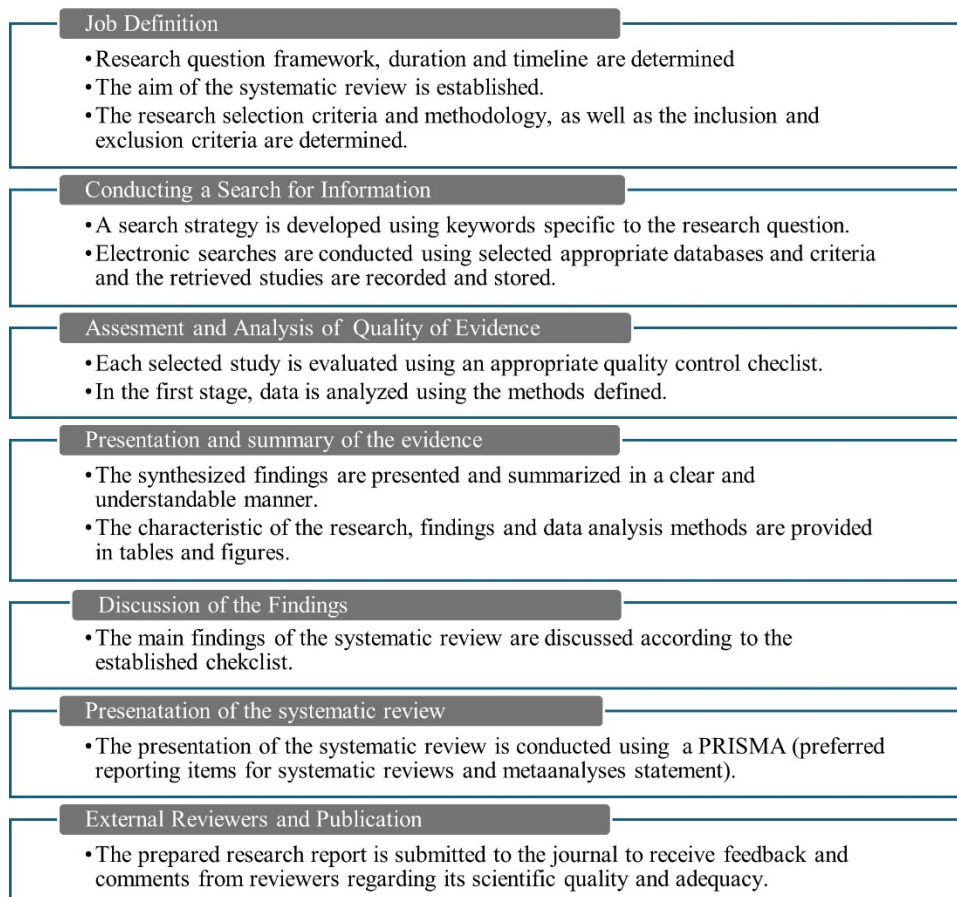


Figure 1. PRISMA Flow Chart

Inclusion and Exclusion Criteria

In this study, research conducted on early childhood EMP children between March 1, 2013, and December 31, 2023, was considered in the literature. Inclusion and exclusion criteria were established, and each article was evaluated based on these criteria:

- Research studies were conducted between 2013 and 2023 in Türkiye, and international literature focused on mathematics education for EMP children aged 0-8, including preschool and primary school-aged children.
- Studies conducted directly with children.
- Peer-reviewed journal articles indexed in DergiPark, TR Index, and Google Scholar in Türkiye.
- Articles indexed in Google Scholar, Taylor & Francis, and Web of Science in the international literature.
- Articles written in Turkish or English, published in scientific journals, allowing full-text access, with titles and abstracts relevant to each other, and covering the early childhood age group, were included in the study. In this context, only journal articles were examined; theses, conference papers, book chapters, and similar works were excluded from the research.

Data Collection Procedures

In this study, conducted as a systematic review, searches were performed in Türkiye using Google Scholar, DergiPark, and TR Index databases to access articles focused on EMP children in early childhood. The researchers searched the Taylor & Francis, Google Scholar, and Web of Science databases for international publications to identify relevant global literature articles. The identification, screening, evaluation, and inclusion of the retrieved articles in the study followed the PRISMA-P guidelines.

Advanced search options were utilised in academic databases, including Google Scholar, DergiPark, Taylor & Francis, and Web of Science, to perform searches using the following keyword groups: early childhood, preschool, primary school, EMP, gifted child, gifted children and mathematics, mathematically giftedness, mathematical creativity, talented children, mathematical ability, gifted children and math, gifted and talented child. The conjunction "and" was used between keywords to identify relevant literature comprehensively. Additionally, the references of the retrieved articles were reviewed to identify studies that may have been overlooked in the initial search results.

The participants of the retrieved research articles were individually reviewed. The following criteria were applied for inclusion in the study: a) Articles involving preschool and primary school classes (ages 0–8), b) Articles written in Turkish or English, c) Articles allowing full-text access, d) Articles conducted directly with children, and e) Articles published in peer-reviewed journals.

The PRISMA flow diagram presents the inclusion process for the articles examined in the study.

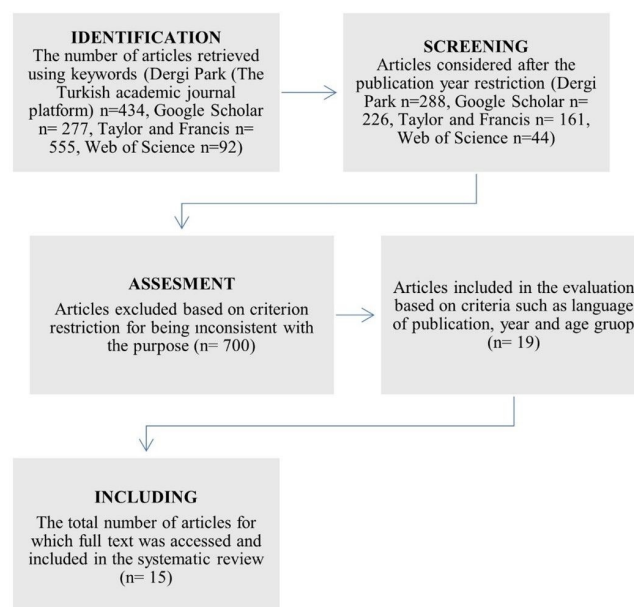


Figure 2. PRISMA Flow Diagram

As shown in Figure 2, searches were conducted using the specified keywords in the aforementioned search engines to identify articles for review. The retrieved articles were evaluated based on inclusion and exclusion criteria. Within this scope, 15 articles were included in the study: seven from the DergiPark database, five from Google Scholar, three from Taylor & Francis, and one from Web of Science. The bibliographic details of the reviewed articles are presented in Table 1. Regarding the publication dates of these articles, five were published in 2023, three in 2018, two in 2019, and one each in 2021, 2022, 2017, 2015, and 2013.

Table 1. Bibliographic details of the reviewed articles

AC	Citation	Country
A1	Özdemir, D. (2019). Number sense conceptions of gifted and talented preschool. <i>Science, Education, Art and Technology Journal</i> , 3(2), 69–77.	Türkiye
A2	Muştuoğlu, E., & Uzun, S. Ç. (2023). Özel yetenekli tanısı konulmuş ilkokul öğrencilerinin asal sayı kavramını inşası: Adidaktik bir ortam örneği [Construction of the prime number concept by elementary school students diagnosed with giftedness: A case study of an adidactic situation.] <i>Van Yüzüncü Yıl University Journal of Education</i> , 20(3), 1058-1084. https://doi.org/10.33711/yyuefd.1323846	Türkiye
A3	Akkaş, E., & Öztürk, F. (2018). Farklılaştırılmış problem çözme öğretiminin üstün yetenekli öğrencilerin problem çözme ve yaratıcı düşünme becerisine etkisi [The effects of differentiated problem solving instruction on problem solving and creative thinking skills of gifted learners]. <i>Milli Eğitim Dergisi</i> , 47(1), 201-224.	Türkiye
A4	Divrik, R. (2023). Comparison of mathematics self-efficacy perceptions of gifted and normally developing primary school students. <i>Journal for the Education of Gifted Young Scientists</i> , 11(3), 381–396. https://doi.org/10.17478/jegys.1360442	Türkiye
A5	Vogelaar, B., Bakker, M., Hoogeveen, L., & Resing, W. C. (2017). Dynamic testing of gifted and average-ability children's analogy problem solving: Does executive functioning play a role? <i>Psychology in the Schools</i> , 54(8), 837-851. https://doi.org/10.1002/pits.22032	Netherlands
A6	Berg, D. H., & McDonald, P. A. (2018). Differences in mathematical reasoning between typically achieving and gifted children. <i>Journal of Cognitive Psychology</i> , 30(3), 281-291. https://doi.org/10.1080/20445911.2018.1457034	Canada
A7	Gavin, M. K., Casa, T. M., Firmender, J. M., & Carroll, S. R. (2013). The impact of advanced geometry and measurement curriculum units on the mathematics achievement of first-grade students. <i>Gifted Child Quarterly</i> , 57(2), 71–84. https://doi.org/10.1177/0016986213479564	ABD
A8	Little, C. A., Adelson, J. L., Kearney, K. L., Cash, K., & O'Brien, R. (2018). Early opportunities to strengthen academic readiness: Effects of summer learning on mathematics achievement. <i>Gifted Child Quarterly</i> , 62(1), 83-95. https://doi.org/10.1177/0016986217738052	ABD
A9	Skarbek, K. (2021). Children with an inclination for mathematical giftedness in early primary school education. <i>Szkoła Specjalna (Special School)</i> , 82(4), 280-296. https://doi.org/10.5604/01.3001.0015.3941	Poland
A10	Divrik, R. (2023). Algorithm-based mathematics from the perspective of gifted students: A case study. <i>Journal of Gifted Education and Creativity</i> , 10(3), 177–193.	Türkiye
A11	Bildiren, A., & Kargın, T. (2019). The effects of project based approach in early intervention program on the problem solving ability of gifted children. <i>Education and Science</i> 44(198). http://dx.doi.org/10.15390/EB.2019.7360	Türkiye
A12	Divrik, R. (2023). Dijital destekli kavram karikatürlerinin özel yetenekli 4. sınıf öğrencilerinin matematik dersi motivasyonlarına etkisi: Karma yöntem araştırması. [The effect of digitally supported concept cartoons on the mathematics lesson motivation of gifted 4th grade students: A mixed method research]. <i>Cumhuriyet International Journal of Education</i> , 12(2): 406-419. https://dx.doi.org/10.30703/cije.1204421	Türkiye
A13	Trinter, C. P., Moon, T. R., & Brighton, C. M. (2015). Characteristics of students' mathematical promise when engaging with problem-based learning units in primary classrooms. <i>Journal of Advanced Academics</i> , 26(1), 24–58. https://doi.org/10.1177/1932202x14562394	ABD
A14	Cheung, S. K., Siu, T. S. C., & Caldwell, M. P. (2023). Mathematical ability at a very young age: The contributions of relationship quality with parents and teachers via children's language and literacy abilities. <i>Early Childhood Education Journal</i> , 51(4), 705–715. https://doi.org/10.1007/s10643-022-01338-x	China
A15	Assmus, D., & Fritzlar, T. (2022). Mathematical creativity and mathematical giftedness in the primary school age range: An interview study on creating figural patterns. <i>ZDM–Mathematics Education</i> , 54(1), 113-131. https://doi.org/10.1007/s11858-022-01328-8	Germany

Data Analysis

In the first analysis stage, the selected articles were numbered from 1 to 15 based on the authors' names and publication years and saved in a designated folder. Each article was coded sequentially as A1, A2, A3, up to A15 within the folder. Subsequently, each article was categorised separately in a classification form based on the research questions. The descriptive analysis of the 15 reviewed articles was presented through tables and graphs created for this purpose.

In this study, the formula for inter-coder reliability proposed by Miles and Huberman (1994) was used to ensure the reliability of the research. First, all articles in the dataset were independently reviewed by two researchers. The following formula was applied to evaluate inter-coder agreement: Reliability Coefficient = (Number of agreed terms) / (Number of agreed terms + Number of disagreed terms) × 100.

This calculation determined the inter-coder reliability for this study to be 92%. Additionally, expert opinions were sought to categorise the mathematical content of the included articles and the data collection tools used in them. The experts included two specialists in early childhood mathematics education and one expert in measurement and evaluation.

Findings

Studies conducted on EMP children in early childhood in Türkiye and worldwide between 2013 and 2023 were analysed, and the findings are presented below in line with the research questions.

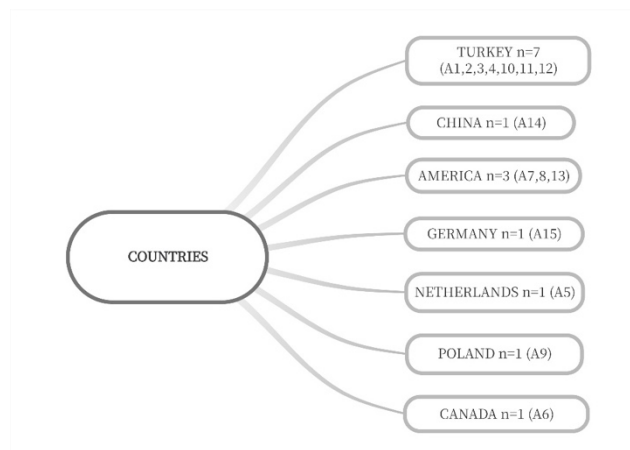


Figure 3. Distribution of Studies by Country

According to Figure 3, an examination of the studies revealed that Türkiye has the highest number of studies focusing on EMP children globally, followed by the United States with three studies, and Canada, the Netherlands, Germany, Poland, and China, each with one study.

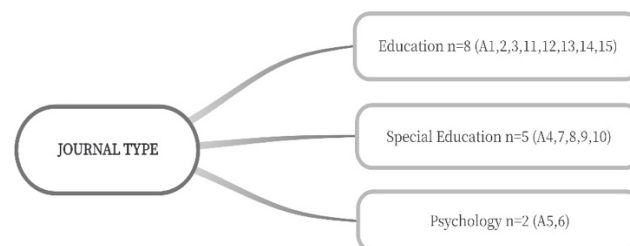


Figure 4. Distribution of studies by journal type

An analysis of the journals in which studies on EMP children were published over the past 10 years reveals that most articles were published in education-focused journals (n=8), followed by journals specialising in special needs (n=5) and psychology (n=2). Among the education-focused journals, some were affiliated with university faculties of education (n=2). In contrast, others included science and education journals (n = 3), journals published by the Ministry of Education (n = 1), and early childhood education journals (n = 1).

Four journals in the special needs category focused on giftedness, while one covered all special needs groups. Additionally, one-third of the reviewed articles were published in Turkish journals.

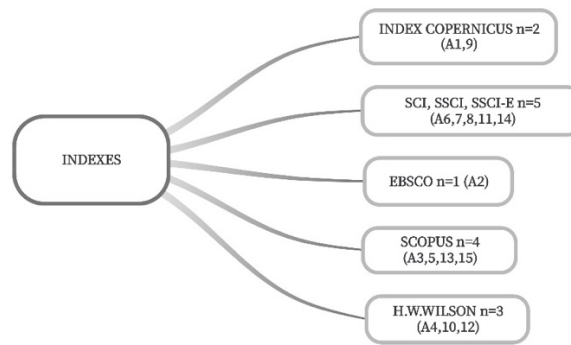


Figure 5. Indexes in which articles are indexed

When examining the indexes of the journals in which the articles were published, it was found that the articles were indexed in SCI, SSCI, and SSCI-E (n=5), Scopus (n=4), H. W. Wilson (n=3), Index Copernicus (n=2), and EBSCO (n=1). In this context, all the reviewed studies were indexed in international databases.

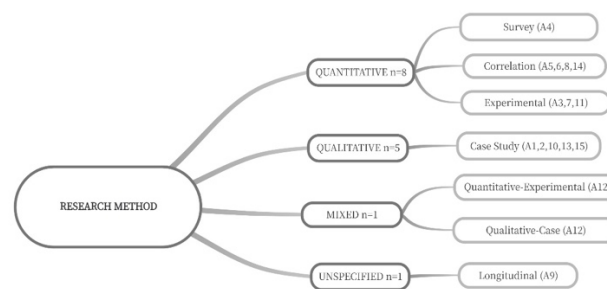


Figure 6. Distribution of articles by research methods

Among the reviewed articles, it was found that quantitative research methods were the most frequently used (n=8), with correlational, experimental, and survey designs being the primary approaches within this category. The case study model was predominantly preferred in qualitative research studies (n=5). The study employed a mixed-methods approach, utilising an experimental design, while the qualitative dimension adopted a case study model. Additionally, one of the reviewed articles was a longitudinal study; however, more information was needed regarding the specific research method employed in the study.

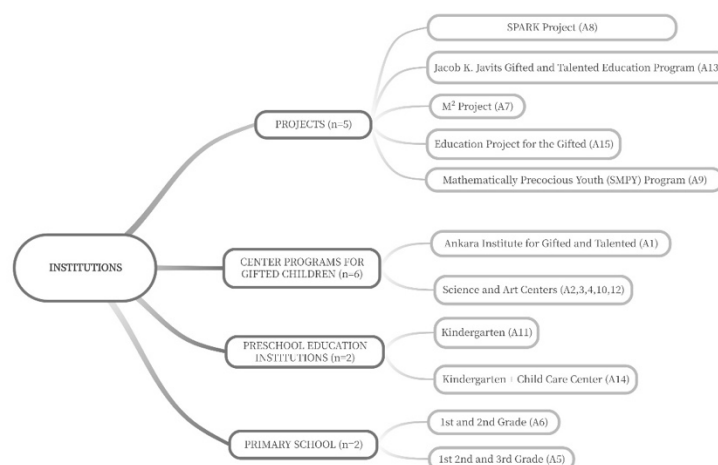


Figure 7. Institutions and scope of the studies

In Figure 7, studies on mathematics in early childhood were analysed based on the educational institutions where they were conducted. Regarding the educational levels, three studies (A1, A11, A14) were conducted at the preschool level, one study (A9) encompassed both preschool and primary school levels, and eleven studies (A2, A3, A4, A5, A6, A7, A8, A10, A12, A13, A15) were conducted exclusively at the primary school level. Two studies involving preschool

children were conducted in preschool education institutions, and one study was carried out at the Ankara Institute for Gifted and Talented (central programs). Based on the institutional analysis of studies on EMP children, the research can be categorised into four groups: studies conducted in preschool education institutions, studies conducted in primary schools, studies implemented in centres and institutes focused on gifted children and studies conducted within the scope of programs and projects designed for this purpose. Studies conducted at the Ankara Institute for Gifted and Talented, as well as the Science and Art Centre (SAC), stand out in the programs developed for gifted children at specialised centres and institutes. In the project category, programs such as the SMPY (A9), SPARK (A8), M² (A7), the University Project for Gifted Education (A15), and the Jacob K. Javits Gifted and Talented Students Education Program (A13) are noteworthy.

Among studies conducted within primary schools, research targeted the 1st and 2nd grades (A6) and the 1st, 2nd, and 3rd grades (A5). Studies conducted under the category of preschool education institutions were carried out in kindergartens (A11) and daycare centres that also provide kindergarten services (A14). When examining the distribution of educational institutions where the reviewed articles were conducted, it is evident that most studies were conducted in programs at centres and institutes focused on gifted children in Türkiye. Among these programs, the SAC is the institution hosting the highest number of studies ($n = 5$). This is followed by two studies conducted in preschool education institutions, one in primary schools and one in other educational institutions serving gifted children.

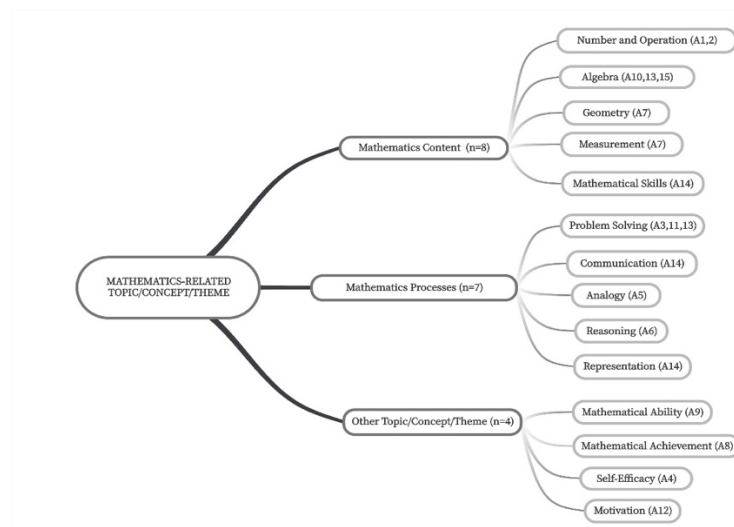


Figure 8. Descriptive Findings on Topics/Concepts in the Articles

The mathematical topics, concepts, and themes studied in the articles were analysed based on the NCTM's mathematical content and process standards. Accordingly, the articles were categorised into three main groups: mathematical content, mathematical processes, and other topics. Under the mathematical content category, topics included numbers and operations, algebra, geometry, measurement, and mathematical skills. The mathematical processes category focused on problem-solving, communication, analogy, reasoning, and representation skills. Other topics related to mathematics, grouped under the "other" category, included mathematical ability, mathematics achievement (A8), self-efficacy (perceptions of mathematical self-efficacy—A4), and motivation (motivation toward mathematics—A12).

The reviewed studies most frequently addressed mathematical content topics, while other mathematics-related topics received the least attention. These findings indicate that studies on mathematical content and process skills were conducted at nearly equal rates.

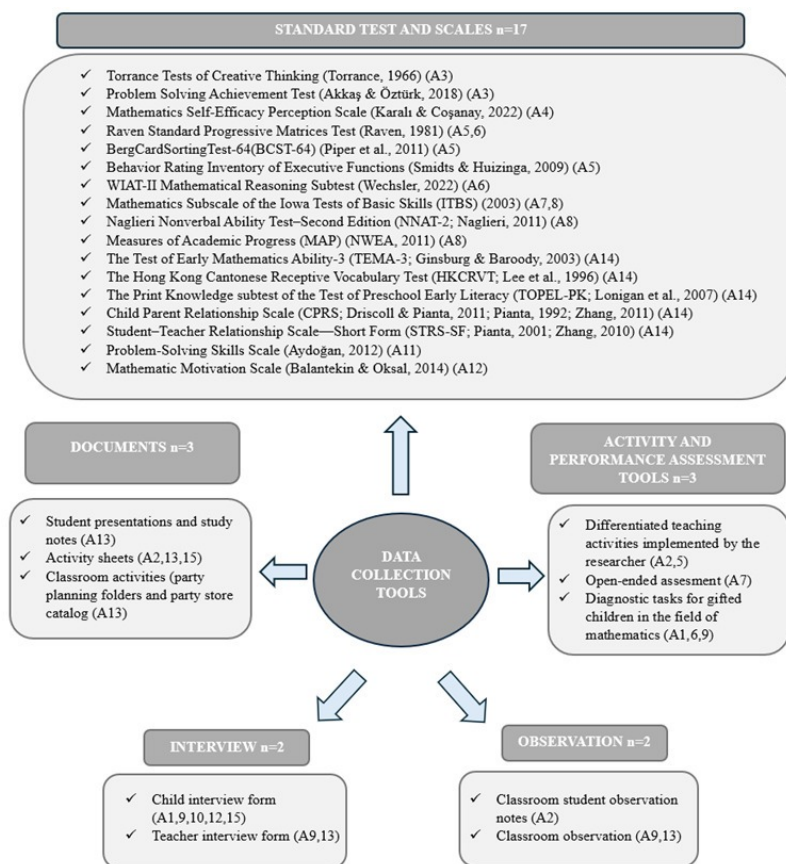


Figure 9. Findings on data collection tools used in the articles

The reviewed articles were categorised into five groups based on the data collection tools: standardised tests and scales, interview tools, observation tools, student activity and performance evaluation tools, and documents. Examining Figure 10 reveals that standardised tests and scales were the most frequently used data collection tools, followed by student activity/performance evaluation tools, document analysis, interviews, and observation tools. Additionally, it was noted that most of the studies employed multiple data collection tools (except for A10 and A11). The studies reveal that standardised tests and scales are used as tools to evaluate children's cognitive, academic, creative thinking, motivation, and self-perception features in a multidimensional manner. This indicates an effort to comprehensively and holistically assess children's development and address their mathematical potential in a contextual and integrative manner. Moreover, tests aimed at identifying relational dynamics were also noted in the reviewed studies.

When examining the tools used to evaluate children's activities and performance, it was found that they primarily included performance-based differentiated instructional activities prepared by researchers within the scope of relevant programs. Diagnostic forms, which offered various tasks and open-ended assessments, were also used to measure children's activities and performance in identifying EMP (e.g., A7).

Conclusion

This study aimed to review research on EMP children in early childhood systematically. When examining the countries where the studies were conducted, it was found that most research was carried out in Türkiye, followed by the United States, Canada, the Netherlands, Germany, China, and Poland. The fact that most studies were conducted in Türkiye is a surprising result attributed to researchers' more straightforward access to national databases and their familiarity with the terms commonly used in the field in Türkiye. On the other hand, considering the inclusion criteria established for the study—limited to articles written in Turkish and English with full-text accessibility—it can be suggested that this restriction may have influenced the results. As a result, studies conducted in countries with significant research activity in mathematics, such as Japan, Singapore, South Korea, and China, were rarely encountered (Mullis et al., 2020; Wu et al., 2020). This could be attributed to the fact that research from these countries is often published in their native languages or journals indexed in national databases. Additionally, it is possible that studies in these regions predominantly focus on older age groups rather than early childhood.

The first step in publishing scientific studies is selecting a journal that aligns with the topic and scope of the research. Therefore, selecting the right journal is crucial to ensure that the study's findings reach the intended audience and contribute to the dissemination of academic knowledge (Gündoğan & Kaya, 2021). At this point, the fact that the reviewed articles are predominantly published in education-focused journals is significant, as it facilitates easier access for educators working in the field to studies conducted on children demonstrating EMP. Following education journals, articles published in journals related to special needs also stand out. The presence of journals specifically dedicated to children with educational needs will facilitate easier access for individuals who work with or have an interest in gifted children (Oruç & Çağır, 2020).

The scientific journal indexes are databases that periodically inform readers about the content of the journals they index through various methods (Asan, 2017). While not all indices are of high quality, the value of a journal is determined by the index in which it is included. An analysis of the indices of the journals in which the reviewed studies were published reveals that Web of Science and Scopus are two of the world's leading databases (Zhu & Liu, 2020). Journals indexed by Thomson Reuters in SCI-E, SSCI, and AHCI, particularly in the fields of health, science, and education, are regarded as the most prestigious, highly cited, and impactful journals (Hu et al., 2018; Liu et al., 2020), followed by Scopus, and subsequently by indexes such as Index Copernicus and EBSCO (Li et al., 2018; Zhu & Liu, 2020). In the current study, more than half of the articles reviewed were published in journals indexed in SSCI-SCI and Scopus, indicating high visibility and impact for these studies. Additionally, the fact that one-third of the articles were published in nationally based journals in Türkiye may be attributed to the country's growing emphasis on the education of gifted children. In the reviewed studies, it was observed that quantitative research methods were predominantly used, followed by qualitative methods.

Within quantitative research, correlational and experimental designs were the most employed. This suggests that studies have focused on identifying variables affecting EMP children, exploring their relationships, and examining their impact on children's performance. In qualitative research, the case study design was utilised. By nature, qualitative research offers opportunities for in-depth exploration with smaller sample groups and subjective interpretation, focusing on individuals and contexts (Gerring, 2017). This approach allows researchers to capture the depth and context often overlooked in quantitative methods, shedding light on complex social dynamics and individual characteristics (Dehalwar & Sharma, 2024). When considered within the specific research context, the in-depth examination of events, environments, programs, and social groups that affect EMP children in early childhood provides unique insights into these children's abilities and educational needs.

In systematic review studies focusing on mathematics-related research conducted with children at various educational levels (Yıldız Altan et al., 2021) and on EMP children (İnan & Uyangör, 2022; Özdemir et al., 2024), it has been identified that quantitative methods are predominantly preferred. Many of these studies have emphasised the need for more detailed findings through qualitative and mixed-methods research, particularly in mathematics education during early childhood. Similarly, considering the findings of this study, it can be highlighted that future research should prioritise studies designed using qualitative or mixed methods approaches.

When examining the studies in terms of their participants, it was found that only three out of the 15 studies focused on EMP children in the preschool period. At the same time, one study included both preschool and primary school children. On the one hand, this finding provides valuable insights into EMP children in early childhood, offering significant information for a deeper understanding of this developmental stage. On the other hand, it highlights the global need for more extensive research to identify EMP children in the preschool period and to support them in realising and developing their potential in this field.

It has been observed that extensive research on high potential in mathematics has been conducted since the early 1900s, with most studies focusing on primary school-aged children (Pavlovic et al., 2018). The findings of the studies reviewed in the present research also support this conclusion. However, Exceptional Mathematical Promise can be identified early in life (David, 2012). Additionally, the bibliometric analysis conducted by Özdemir et al. (2024) of studies on EMP from 1960 to 2023 revealed that only limited information is available regarding historical and current

trends in this field. Furthermore, it was found that connections between publications, significant journals, countries, institutions, authors, and researchers, in terms of both past and current dynamics, have yet to be fully explored.

Additionally, a study examining research on EMP in mathematics from 1960 to 2023 observed an increasing trend in the first (1960-1979) and the second (1980-2011) period. However, in the third period (2012-2023), there was a significant decrease in the number of studies, which can be attributed to a decline in the productivity of researchers working in this field. In this context, considering that the field of preschool education in Türkiye became more prominent after 1998 when compulsory education was extended to 8 years, and the Council of Higher Education restructured faculties of education to include preschool education under the primary education umbrella, it can be argued that this is a relatively new field in Türkiye. Consequently, research in this area became more comprehensive and varied in the 2000s (Deretarla Gül, 2018). Similarly, although a longstanding system in Türkiye, dating back to the Ottoman Empire, existed through the Enderun Schools, research on the education of gifted children in the Republic of Türkiye began only after the 1990s (Leana-Taşçılar et al., 2016; Sak, 2017). This situation helps explain the relatively limited research on EMP children in the preschool period in Türkiye, as well as the greater volume of studies compared to other countries.

Additionally, about the importance of early identification of EMP children and providing them with appropriate education based on their potential, a longitudinal study conducted in Poland (A7), spanning from preschool to the second grade of primary school, found a significant number of EMP children. The study determined that the tendency for EMP could be effectively identified in preschool children and concluded that most children who exhibited EMP in preschool stopped demonstrating this performance after the first few months of primary school (Skarbek, 2021). This highlights the importance of early diagnosis and intervention, underscoring the need for more targeted research on EMP children, particularly in early childhood.

The present study also observed that more than two-thirds of the research on EMP children was conducted within programs and projects established at centres and institutes focused on gifted children. In contrast, the remaining studies were conducted in preschool and primary schools. Notably, studies conducted in Türkiye focused on EMP children identified within the framework of the SAC (A1, A2, A3, A4, A10, A12). The study conducted in the Netherlands (A5) found that gifted children were educated separately from their peers in a primary school setting. The studies from the United States (A7, A8, A13) were conducted within university-based projects led by experts, following various grant programs related to gifted children. Meanwhile, in the Poland (A9) study, EMP children identified in kindergarten were also followed in first and second grade to track their educational progress.

Finally, in Germany (A15), a study conducted with elementary school students enrolled in the Gifted Education Project at Martin Luther University aimed to compare the mathematical structure and pattern usage skills of EMP children with those of their non-gifted peers. It can be said that the remaining studies conducted in preschool institutions and primary schools were primarily the result of the researchers' efforts. In conclusion, studies on EMP children are concentrated in the United States and Türkiye. While universities in the United States are among the most productive institutions for research on EMP children, in Türkiye, institutional programs and initiatives developed by the Ministry of National Education for gifted children are more prominent. Considering that research on gifted children in Türkiye gained momentum in the 1990s following the establishment of the Republic, it is noteworthy that in 1995, the SACs were founded as resource centres where gifted students in primary and secondary education receive education in alignment with their interests and abilities outside of formal schooling hours (MoNE, 2016). The essential criterion for student selection for SACs is administering an intelligence test, with students who score 130 or above on the IQ test being admitted to the centre. According to the Ministry of National Education (MoNE, 2024), as of 2024, approximately 63,000 gifted children are receiving education in 182 SACs across 81 provinces in Türkiye. Therefore, SACs are considered the primary data source for identifying gifted children in early childhood in Türkiye. Indeed, among the seven studies conducted in Türkiye that the present study reviewed, four involved elementary school-aged children receiving education at SACs.

When examining the reviewed studies regarding the topics, concepts, and themes addressed in mathematics, it becomes apparent that there is a balanced distribution in terms of content and process standards, based on the NCTM standards. The NCTM, the National Council of Teachers of Mathematics, established in the United States, has conducted studies that many countries have followed. NCTM (2006) outlined the general principles of mathematics for K-12 levels, explaining the content and process standards of mathematics, and argued that mathematical skills and processes should be learned not through rote memorisation but through interaction with materials, peers, adults, and the environment, understanding the concepts. Additionally, the council emphasised that mathematics education should involve both content standards, which define the mathematical content children need to learn at each grade level and process standards, which focus on the different methods used to understand and apply content in mathematics education (Charlesworth & Lind, 2013). In the studies reviewed in the present study, a positive finding is that mathematical content and processes were addressed at similar levels. However, future studies would benefit significantly from emphasising the examination of content and processes together. This approach would be particularly valuable in helping children realise their potential in mathematics.

In the studies related to EMP, it was observed that standardised measurement tools were predominantly used, although relatively fewer studies incorporated interviews, observations, tools for evaluating children's activities and performance, and documents. Upon examining the studies, it was found that multiple measurement tools were mainly used (except for A10 and A11). Researchers did not rely solely on standardised measurement tools but also adopted an approach that enriched the data obtained from these tools with additional data collected through interviews, observations, and other measurement tools. This approach aimed to enhance the reliability and validity of the research data (Fraenkel et al., 2012; Sözbilir et al., 2012).

A critical examination of the content of existing studies reveals that, in most cases, children's advanced mathematical performance is assessed based on their early abilities such as number recognition, sequencing, and basic arithmetic operations. These assessments are often conducted in comparison to typically developing peers. However, there is a clear need for studies that also consider the abilities of mathematically gifted children in mathematical thinking, mathematization, and the use of mathematical language, as well as their understanding of broader mathematical concepts, such as graphing, measurement, and spatial relationships. In this context, the development of appropriate assessment tools tailored to these advanced competencies is also required.

Furthermore, there is a notable scarcity of research focusing on the mathematical knowledge, skills, competencies, and perspectives of teachers and families, who are the most critical supporters of children in early childhood and play a vital role in recognising and fostering their mathematical potential. Most existing studies appear to rely on individual efforts and do not adequately address these key stakeholders.

Additionally, incorporating variables that may influence gifted children's mathematical abilities—such as motivation, creativity, thinking skills, representation, and making connections—within the framework of developmental and learning theories would make a valuable contribution to the literature. Among the reviewed studies, only one focused on disadvantaged children. Therefore, it is essential to examine the impact of factors such as poverty, rural living, ethnicity, gender, language, culture, and race on the mathematical achievement of EMP children. Doing so would provide critical data for planning their educational processes and for identifying effective educational strategies that enable these children to realise their potential fully.

In conclusion, research on EMP children in early childhood over the past decade has shown that Türkiye and the United States are the most frequently studied countries. Most studies were conducted using quantitative research methods and were published in journals indexed in SCI, SSCI, SSCI-E, and Scopus, which focus on educational content. The reviewed studies were primarily conducted within the context of programs, institutes, and projects serving gifted children rather than within institutional structures. Although it has been observed that mathematical content and process standards are incorporated in a balanced manner according to NCTM standards, many factors that may influence mathematical ability appear to have been overlooked. Additionally, standardised tests and scales were predominantly used as data collection tools, but in most studies, multiple measurement tools were employed to enhance

the validity and reliability of the data. The articles reviewed were limited to research directly involving children, published in Turkish and English, and accessible through selected keywords and databases with full-text access, as defined by the inclusion and exclusion criteria. Therefore, future research could expand the scope by accessing publications in other databases, languages, graduate theses, and institutional reports, potentially yielding more detailed results and contributing further to the field.

Literature reviews aim to gather information from a broad dataset to obtain more comprehensive insights through the analyses conducted. However, the minimal number of studies on EMP children in early childhood can be considered one of the main limitations of this research. Today's technological advancements increasingly highlight the importance of developing high potential in mathematics at an early age. Therefore, identifying children with exceptional mathematical abilities during early childhood, considered the "golden years," for realising their potential and reaching the highest possible level is crucial for all societies. To achieve this, ministries of education and universities in various countries must collaborate on projects and programs for all children, particularly those in early childhood. Such initiatives will provide valuable strategies to offer more qualified and sustainable programs for EMP children.

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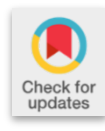
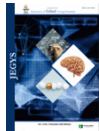
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Research Article

Service innovation in enhancing academic quality at private higher education institutions in Gorontalo: a theoretical conceptual model analysis of innovation diffusion using the SEM-PLS approach

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Article Info	Abstract
Received: 29 August 2025 Accepted: 30 September 2025 Online: 30 Sept 2025	Private higher education institutions in Gorontalo face challenges in improving academic quality due to limited understanding of the impactful dimensions of service innovation and the absence of a comprehensive conceptual model that explains the relationship between service innovation and academic quality. This study aims to develop and test a conceptual model of the influence of service innovation on academic quality at private higher education institutions in Gorontalo using the SEM-PLS approach. The research employed a quantitative explanatory approach with a total sample of 426 respondents from 11 private universities in Gorontalo, collected via an online structured questionnaire distributed through Google Forms. The instrument was developed based on literature reviews and previous empirical studies, using a 5-point Likert scale to measure perceptions. The findings show that service innovation has a dominant influence on academic quality ($\beta = 0.482, p < 0.000$), sustainable innovation governance principles have a significant effect ($\beta = 0.349, p < 0.000$), and a moderating effect strengthens the relationship between the two ($\beta = 0.081, p = 0.002$). Private universities require a harmonious integration between service innovation and sustainable governance to achieve optimal and sustainable improvements in academic quality.
Keywords Academic quality Private higher education SEM-PLS Service innovation Sustainable innovation governance principles	
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Introduction

Higher education institutions play a strategic role in producing quality human resources capable of contributing to national development (Adedeji & Campbell, 2013; Sebola, 2023; Zaakiyyah, 2024). In the era of globalization and the Fourth Industrial Revolution (Industry 4.0), demands for academic quality in universities are increasing not only in curriculum and learning processes but also in supporting services provided to students (Jung, 2020). Academic quality is a key indicator of a university's success in fulfilling its tri dharma functions education, research, and community service (Nugraha et al., 2023). Indonesia's higher education has undergone significant transformation in recent decades (Aneta et al., 2025), marked by the growth of private universities that meet public demand for higher education. However,

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private universities face unique challenges in maintaining academic quality, particularly in competing with public universities that benefit from stronger financial support and facilities (Aithal & Kumar, 2016; Dill, 2001; Garwe, 2014). In this context, service innovation becomes a crucial strategy for private universities to sustain competitiveness and improve academic quality. Service innovation in higher education encompasses academic information systems, administrative improvements, learning facilities, and responsive academic programs aligned with labor market needs. It also includes pedagogical innovations, evaluation systems, and student-centered services. Research shows that academic service quality strongly influences student satisfaction and loyalty, which in turn correlates positively with institutional performance (Supriyanto et al., 2024).

Gorontalo Province located in Eastern Indonesia, provides a unique context for higher education development. Despite its strategic position and resource potential, private universities in Gorontalo encounter constraints such as limited resources, restricted access to technology, and competition with more established public institutions. These challenges resonate with broader findings highlighting the importance of industry, innovation, and infrastructure in strengthening higher education's role in sustainable development (Ashida, 2022; Islam & Ali Khan, 2023; Leal Filho et al., 2019; Owens, 2017). Most private universities in the province remain accredited at levels B and C, reflecting the need for academic quality enhancement (Lambey et al., 2023; Logli, 2016; Moeliodihardjo, 2014).

Academic quality in higher education can be assessed through indicators such as curriculum quality, faculty competence, learning facilities, research outcomes, and stakeholder satisfaction (Razinkina et al., 2018; Rowley, 1996; Ruben, 1999; Varouchas et al., 2018). Yet, Indonesia's global rankings remain low, and in the context of private universities, academic quality is closely linked to student retention, graduation rates, and graduate employability. Improving quality therefore requires a holistic approach involving both academic and non-academic services (Arsana et al., 2025). To examine these complex relationships, this study employs Structural Equation Modeling with Partial Least Squares (SEM-PLS). PLS-SEM has been recognized as a robust alternative to covariance-based SEM for educational research (Sarstedt et al., 2021), and recent methodological guidelines stress its rigor in conceptual model testing (Becker et al., 2023; Cheah et al., 2023; Richter et al., 2020).

Several key issues remain unresolved in private universities in Gorontalo: (1) limited understanding of the most influential dimensions of service innovation in enhancing academic quality; (2) absence of a comprehensive model that explains the link between service innovation and academic quality in regional private universities; (3) resource limitations hindering effective implementation of innovations; and (4) scarcity of empirical studies addressing these issues in Eastern Indonesia. UNESCO (2024) emphasizes the urgency of unleashing innovation and digital transformation, but practical implementation remains weak in private institutions. Most existing studies on service innovation in higher education have been conducted in developed countries, with limited applicability to Indonesia's context. Research in Indonesian private universities, especially in regional settings, is still descriptive and lacks comprehensive modelling approaches. Thus, research gaps can be identified as follows: (1) limited application of SEM-PLS in analysing higher education service innovation in Indonesia; (2) absence of studies focusing on private universities in Eastern Indonesia; (3) lack of conceptual models explaining how service innovation affects academic quality locally; and (4) insufficient integration of service innovation dimensions into a comprehensive analytical framework.

Based on these gaps, this study aims to develop and test a conceptual model on the influence of service innovation on academic quality at private higher education institutions in Gorontalo using the SEM-PLS approach. Specifically, it seeks to: (1) identify and analyse service innovation dimensions implemented by private universities in Gorontalo; (2) measure academic quality using established indicators; (3) develop a conceptual model linking service innovation to academic quality; (4) test its validity and reliability; and (5) provide strategic recommendations for private universities to strengthen academic quality through service innovation.

Literature Review

Public Service Management

Public service management refers to a series of service activities that are systematically organized by prioritizing the implementation of management functions and optimizing the utilization of available resources to accelerate the

achievement of public service goals. The concept of Reinventing Government has significantly influenced the acceleration and evolution of public management. This paradigm, initiated by (Osborne & Gaebler, 1995) and later operationalized by Osborne and Plastrik around 1997, proposes that governments should embody the following characteristics: (1) Catalytic, (2) Community-owned, (3) Competitive, (4) Mission-driven, (5) Results-oriented, (6) Customer-driven, (7) Enterprising, (8) Anticipatory, (9) Decentralized, and (10) Market-oriented (Muhammad, 2019). While these principles offer a comprehensive framework for modernizing public service delivery, their strong reliance on market-oriented logics often creates tension when applied to higher education institutions, where equity and inclusivity should be prioritized over efficiency. This gap highlights the need for a more nuanced adaptation of Reinventing Government principles in academic contexts, particularly in private universities that balance both commercial pressures and educational missions. In the context of private universities in Indonesia, the tension between efficiency-driven reforms and the broader mission of education particularly fostering inclusivity and sustainability raises critical questions for both policy and practice. Thus, this study extends the discussion by examining how principles of public service management are selectively adapted and contextualized within academic settings, especially when the aim is to enhance educational quality rather than merely efficiency.

Service Innovation

Concept To improve academic quality, higher education institutions must understand that the adoption of service innovation depends largely on how individuals be they faculty members, students, or administrative staff perceive the characteristics of the innovation itself. According to Rogers, there are five key characteristics that influence the rate of innovation adoption: relative advantage, compatibility, complexity, trialability, and observability (Rogers, 2003). These five dimensions can be internalized as strategic benchmarks for designing, implementing, and evaluating academic service innovations in higher education.

Existing studies largely affirm these dimensions in explaining technology adoption in higher education (Almarashdeh, 2016; Oyetade et al., 2020). However, more recent research suggests that contextual factors such as institutional culture, leadership commitment, and sustainability orientation play equally crucial roles (Amtu et al., 2021; Iqbal et al., 2025). Yet, these studies often treat Rogers' five attributes as universally applicable, overlooking how institutional culture, leadership commitment, and sustainability orientation condition their effectiveness. In this respect, the present study advances the discourse by critically examining how these contextual factors reshape the meaning and impact of service innovation in private universities. For example, while relative advantage emphasizes perceived efficiency, in practice, private universities often face challenges related to resource constraints and varying levels of digital literacy, which complicate adoption beyond mere technological superiority.

Moreover, compatibility and complexity appear to interact dynamically. In conservative or hierarchical academic environments, even relatively simple innovations may encounter resistance if they disrupt entrenched norms. Conversely, innovations perceived as complex may gain traction if they align with institutional aspirations, such as international accreditation or global competitiveness. This suggests that Rogers' model, while foundational, requires contextual adaptation to higher education systems that operate under both academic and market pressures.

Trialability and observability have also been highlighted in recent scholarship as mechanisms for reducing resistance and building collective trust. Pilot projects and visible success stories not only demonstrate practical benefits but also serve as instruments of cultural change within academic communities. However, a critical gap in the literature lies in sustainability: while short-term adoption is often studied, less attention is given to how service innovations can be institutionalized and continuously improved in private universities. This is where the present study aims to contribute.

Academic Quality

According to Kotler & Fox, the quality of education comprises six interrelated dimensions that contribute to creating an optimal and productive educational environment (Darwyansyah, 2014). These dimensions include instruction quality, academic advising, library and academic resources, extracurricular activities, faculty-student interactions, and job placement services. Together, they form a multidimensional framework for assessing educational quality.

Although widely cited, this framework has been critiqued for being overly student-centric and less attentive to institutional and societal expectations (Harvey & Green, 1993). Subsequent research highlights that academic quality must also be understood in relation to governance structures, stakeholder participation, and responsiveness to labor market dynamics. In the Indonesian context, particularly in private universities, the emphasis often shifts toward employability and accreditation, which can both enrich and constrain the holistic development of educational quality.

Thus, while Kotler and Fox's dimensions remain relevant, they are insufficient for capturing the multi-stakeholder demands placed on private universities in Indonesia. By integrating sustainability and governance perspectives, this study challenges the student-centric bias in earlier models and positions service innovation as a systemic approach to enhancing academic quality.

Method

Research Design

This study employs a quantitative approach with an explanatory research design, aiming to explain the causal relationship between service innovation and academic quality in private universities in Gorontalo. This design was chosen to align with the objective of developing and testing a conceptual model using Structural Equation Modeling with a Partial Least Squares approach (SEM-PLS). Explanatory research was selected because it not only describes existing phenomena but also tests hypotheses and explains causal relationships between variables (Creswell, 2009).

Sampling

The sampling technique applied in this study is non-probability sampling with a convenience sampling method. This method was chosen for its accessibility and efficiency in collecting data through digital platforms (Google Forms). According to (Hair et al., 2014), for SEM-PLS analysis, the minimum sample size should be ten times the largest number of indicators in a construct or ten times the number of structural paths leading to a specific endogenous construct.

Data Collection

In this study, questionnaires were distributed via Google Forms to respondents from 11 private universities in Gorontalo. The distribution was facilitated by student and faculty coordinators at each institution to ensure an even spread. Of the total distributed, 426 respondents completed the questionnaire in full. Based on the collected data, the researcher decided to use all 426 respondents as the study sample (total sampling). This decision was made considering that the sample size of 426 is highly adequate for SEM-PLS analysis and provides high statistical power. According to Cohen (1992), a sample size of 426 is considered large and can provide statistical power greater than 0.80 with a medium effect size (0.15) at a significance level of 0.05 (Cohen, 2016).

Primary data were obtained through a survey using a structured questionnaire distributed via Google Forms. The questionnaire was designed based on literature reviews and previous empirical studies. Each item in the questionnaire employed a 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

Indicators and Instruments

Service Innovation refers to systematic efforts undertaken by private universities to introduce, develop, and implement new service approaches, technologies, or systems aimed at enhancing student academic experiences, teaching effectiveness, and administrative efficiency. The construct encompasses both intrinsic dimensions related to how the academic community perceives innovation, and extrinsic dimensions related to the institution's readiness to adopt the innovation systemically. The intrinsic factor refers to innovation characteristics that affect the likelihood of adoption by individuals or units within the institution. Five key indicators are used to describe this dimension: relative advantage, compatibility, complexity, trialability, and observability. The extrinsic factor reflects the readiness of the institutional environment in supporting the successful implementation of service innovations. Four indicators describe this dimension: policy pressure, infrastructure availability, institutional ecosystem readiness, and human resource readiness (Arsana et al., 2025).

Academic Quality is operationalized as the perceived level of quality achieved by higher education institutions in carrying out academic functions, including learning, academic advising, support resources, and graduate readiness for

the job market. In this study, academic quality is positioned as the dependent variable influenced by service innovation and the principles of sustainable innovation governance. Based on the concept by Kotler & Fox, academic quality includes six main indicators: quality of instruction, academic advising, library resources, extracurricular activities, opportunities to interact with faculty, and job placement services (Darwyansyah, 2014).

Principles of Sustainable Innovation Governance are operationalized as a set of managerial and organizational principles ensuring that service innovation can be implemented sustainably beyond symbolic or temporary measures. This variable acts as a moderating variable that strengthens the relationship between service innovation and academic quality in private universities. Seven main indicators shape this variable: commitment, consistency, communication, coordination, collaboration, cooperativeness, and creativity (Arsana et al., 2025).

Table 1. Indicators and Instruments

Variable	Indicator	Instruments
Service Innovation	Relative Advantage	The new services implemented by the university provide greater benefits compared to previous services.
	Compatibility	The service innovations implemented are aligned with the needs and values upheld by the academic community.
	Complexity	The level of difficulty in understanding and using the service innovations.
	Trialability	The innovative services can be tested or used on a limited basis before being fully implemented.
	Observability	The outcomes and benefits of the service innovations can be clearly observed by users.
	Policy Pressure	The push from government regulations or policies that encourage universities to adopt service innovations.
	Infrastructure Availability	The availability of facilities and infrastructure that support the implementation of service innovations.
	Institutional Ecosystem Readiness	The readiness of systems, organizational culture, and internal support to implement service innovations.
	Human Resource Readiness	The competence and skills of university human resources in managing and utilizing service innovations.
Academic Quality	Quality of Instruction	Lecturers deliver course materials clearly and in a way that is easy to understand.
	Academic Advising	Academic advisors provide useful guidance related to my studies.
	Library Resources	The library provides adequate and relevant learning resources to support my studies.
	Extracurricular Activities	Campus extracurricular activities support the development of my soft skills.
	Opportunities to Talk with Faculty	I have sufficient opportunities to directly discuss with lecturers outside of class hours.
	Job Placement Services	The university's career guidance services help me prepare for the job market.
Principles of Sustainable Innovation Governance	Commitment	University leaders demonstrate strong dedication in supporting service innovations.
	Consistency	The implementation of service innovations is carried out continuously without interruption.
	Communication	Information related to service innovations is communicated openly and clearly to all stakeholders.
	Coordination	Work units coordinate with each other in implementing service innovations.
	Collaboration	The university builds partnerships with external parties to support service innovations.
	Cooperativeness	The academic community demonstrates a spirit of mutual support in carrying out service innovations.
	Creativity	The university encourages new ideas to enhance service innovations.

Data Analysis

Data were analyzed using the SEM-PLS approach with SmartPLS software. The analysis covered three main stages: evaluating the outer model (convergent validity, discriminant validity, and reliability), assessing the inner model (R^2 , Q^2 , and goodness-of-fit), and testing the research hypotheses through path coefficients, t-statistics, and p-values.

Results

Model Testing Design

Model testing in this study was conducted to examine the relationships between variables within a conceptual framework developed based on theoretical reconstruction, the discovery of new concepts, and the development of a service innovation model for academic quality, moderated by the principles of sustainable innovation governance. The analysis was carried out using SmartPLS software version 4.1.1.4, applying the Partial Least Squares (PLS) method to evaluate complex variable relationships in the model, while SEM (Structural Equation Modeling) was used to assess the causal relationships among variables.

Outer Model

The outer model focuses on the relationship between latent variables and their indicators. Testing the outer model aims to ensure that the instruments used to measure the latent variables have strong validity and reliability. There are three main types of testing within the outer model: Convergent Validity, Discriminant Validity, and Construct Reliability.

Convergent Validity

Loading Factor Values The outer loading values are derived from the correlation between each indicator (instrument) and its respective construct (variable). An indicator is considered valid if it has a correlation (loading) value above 0.70 (or 0.60 is considered acceptable). Indicators that do not meet this criterion should be excluded.

Table 2. Outer loading results convergent validity test

Construct	Loading Range	Notes
Service Innovation (SI)	0.770 – 0.836	All indicators valid
Academic Quality	0.780 – 0.830	All indicators valid
Principles of Sustainable Innovation Governance (PSIG)	0.797 – 0.836	All indicators valid
PSIG × SI (Interaction/Moderation)	1.000	Valid

Source: SEM-PLS Analysis Results (2025)

Based on the convergent validity test, all indicators have outer loading values above the threshold of 0.70, and thus are declared valid. Therefore, all indicators in the table meet the criteria for convergent validity and can be used.

Average Variance Extracted (AVE)

Table 3. AVE results – convergent validity test

Variable	AVE	Notes
Service Innovation	0.664	Valid
Academic Quality	0.648	Valid
Principles of Sustainable Innovation Governance	0.667	Valid

Source: SEM-PLS Analysis Results (2025)

Based on the AVE results, all variables have AVE values greater than 0.50. This means that the indicators for each construct are capable of explaining more than 50% of the variance, thus confirming their convergent validity.

Discriminant Validity

Discriminant validity ensures that each construct in the measurement model truly measures a distinct concept and does not overlap with others. It assesses how well constructs that are supposed to be unrelated are actually distinct from one another. Discriminant validity is evaluated using Fornell-Larcker Criterion.

Table 4. Fornell-Larcker criterion

Construct	SI	AQ	PSIG	Description
SI	0.815			Valid
AQ	0.753	0.805		Valid
PSIG	0.745	0.706	0.817	Valid

Source: SEM-PLS Analysis Results (2025)

In testing discriminant validity using the Fornell-Larcker criterion, the primary principle is that the square root of the Average Variance Extracted ($\sqrt{AVE}$) for each construct must be greater than its correlation with other constructs. In

other words, a construct is considered to have good discriminant validity if it correlates more strongly with its own indicators than with those of other constructs in the model.

The $\sqrt{\text{AVE}}$ value for the service innovation construct (SI) is 0.815, which is higher than its correlation with academic quality (AQ) (0.753) and with sustainable innovation governance principles (PSIG) (0.745). This indicates that SI has good discriminant validity as it clearly distinguishes itself from other constructs. Similarly, the AQ construct has a $\sqrt{\text{AVE}}$ of 0.805, which is also greater than its correlations with SI (0.753) and PSIG (0.706). This confirms that AQ meets the criterion, where its indicators primarily measure the AQ construct itself. The PSIG construct has a $\sqrt{\text{AVE}}$ of 0.817, exceeding its correlations with SI (0.745) and AQ (0.706), which means PSIG also demonstrates distinctiveness in measurement.

Based on these results, all constructs in the model meet the Fornell-Larcker discriminant validity criteria. This implies that each construct is clearly distinguishable from the others in the PLS-SEM model, and there is no significant overlap in the measurement among constructs.

Construct Reliability

Table 5. Cronbach’s Alpha and Composite Reliability Values

Variable	Cronbach’s Alpha	Composite Reliability	Description
Service Innovation	0.970	0.973	Reliable
Academic Quality	0.961	0.965	Reliable
Principles of Sustainable Innovation Governance	0.962	0.966	Reliable

Source: SEM-PLS Analysis Results (2025)

Based on the reliability testing of the three research variables, the Cronbach’s Alpha values obtained were: Service Innovation 0.970, Academic Quality 0.961, and Sustainable Innovation Governance 0.962. All values exceed 0.9, indicating a very high level of reliability. According to Becker et al. (2014), a Cronbach’s Alpha of ≥ 0.70 is considered acceptable for internal consistency, while values ≥ 0.90 indicate very strong internal consistency.

Composite Reliability is a primary tool for measuring reliability, and values ≥ 0.7 are considered acceptable. The composite reliability for Service Innovation is 0.973, indicating very high internal consistency among its indicators. Similarly, Academic Quality (0.965) and Principles of Sustainable Innovation Governance (0.966) also demonstrate very strong construct reliability.

Thus, all three constructs in this model meet the reliability criteria, meaning that the indicators can consistently be used to measure their respective constructs. This provides a strong foundation for progressing to convergent and discriminant validity testing, as well as structural model evaluation.

Model Fit Test

The model fit test was conducted using output from SmartPLS version 4.1.1.4 and compared against standard thresholds, as shown in the following table:

Table 6. Model fit test results

Parameter	Rule of Thumb	Estimated Model	Description
SRMR	SRMR < 0.08 (good)	0.038	Good
d_ULS	The smaller, the better	1.605	Good
d_G	The smaller, the better	1.174	Good
Chi-square	The smaller, the better	2480.549	-
NFI	Closer to 1 is better	0.871	Fit
Q ² Predictive Relevance	Q ² > 0: Predictive relevance Q ² < 0: Lack of relevance 0.02 (Weak), 0.15 (Moderate), 0.35 (Strong)	Service Innovation: 0.598 Academic Quality: 0.570 Sustainable Innovation Governance: 0.592	Strong

Source: SEM-PLS Analysis Results (2025)

Based on the model fit test results, the research model shows very good structural suitability. The SRMR (Standardized Root Mean Square Residual) for the estimated model is 0.038, well below the threshold of 0.08, indicating

a very small difference between the observed and predicted covariance matrices. The values of d_ULS (1.605) and d_G (1.174) are also low, supporting that the model structure represents the data adequately.

The Chi-Square value of 2480.549 is relatively low, suggesting no significant deviation between the actual and model-predicted covariance matrices. The NFI (Normed Fit Index) score of 0.871 is close to the ideal value of 1, indicating a high level of model fit and strengthening the structural validity of the relationships among constructs.

Regarding predictive relevance (Q^2), all endogenous constructs show high Q^2 values: Service Innovation – 0.598, Academic Quality – 0.570, and Sustainable Innovation Governance – 0.592. These values are all above 0.35, which indicates strong predictive relevance. In other words, the model not only adequately describes the relationships among constructs but also has strong predictive power.

Hence, the research model meets excellent model fit criteria and possesses strong predictive relevance. This suggests the model is both statistically valid and substantively relevant in explaining and predicting variables related to service innovation, academic quality, and sustainable innovation governance in higher education.

Inner Model

The inner model in PLS-SEM represents the relationships between latent variables and is evaluated based on three main aspects: R Square, hypothesis testing (significance of relationships), and F Square/Effect Size.

R-Square (R^2)

R-Square in PLS-SEM measures how well the latent independent variables in the model explain the variability of the latent dependent variable. The R^2 value indicates the overall predictive power of the model. R^2 ranges from 0 to 1, with higher values indicating a better model in explaining variance. The R-Square values for this analysis are presented below:

Table 7. R Square (R^2) test results

Dependent Variable	R-square	R-square Adjusted
Academic Quality (AQ)	0.623	0.621

Source: SEM-PLS Analysis Results (2025)

An R^2 value of 0.623 means that 62.3% of the variance in Academic Quality can be explained by the independent constructs: Service Innovation and the Principles of Sustainable Innovation Governance. The remaining 37.7% is explained by other variables not included in this model, such as lecturer roles or students' social conditions. According to (Hair et al., 2019), R^2 values are classified as follows: $R^2 > 0.75$ = substantial (strong), $0.50 \leq R^2 \leq 0.75$ = moderate and $0.25 \leq R^2 < 0.50$ = weak. Thus, an R^2 of 0.623 falls into the moderate category, indicating the model has a reasonably strong predictive capability in explaining Academic Quality.

Effect Size (F^2)

Effect size (F^2) is used to evaluate the specific impact of independent variables on predicting the dependent variable. It is measured by observing the change in R^2 when a particular independent variable is removed from the model. The f^2 values are interpreted as follows: $f^2 < 0.02$ = very small, $0.02 \leq f^2 < 0.15$ = small effect, $0.15 \leq f^2 < 0.35$ = medium effect and $f^2 \geq 0.35$ = large effect. For moderation effects, (Kenny, 2018) in (Hair et al., 2021) suggests: $f^2 < 0.005$ = very small, $f^2 < 0.01$ = moderate and $f^2 \geq 0.025$ = large.

Calculating f^2 allows researchers to identify which independent variables have the greatest influence on the dependent variable, offering deeper insights into the dynamics between latent variables.

Table 8. Effect Size (f^2) test results

Construct	Academic Quality
Service Innovation (SI)	0.264
Principles of Sustainable Innovation Governance (PSIG)	0.140
PSIG x SI	0.024

Source: SEM-PLS Analysis Results (2025)

The results show that, Service Innovation (SI) affects Academic Quality with an f^2 value of 0.264, which falls in the medium effect category. This indicates that service innovation has a substantively strong contribution in explaining academic quality in higher education. Principles of Sustainable Innovation Governance (PSIG) has an f^2 of 0.140, which

is a small effect. Though not as influential as service innovation, PSIG still plays a meaningful role in enhancing academic quality. The interaction between PSIG and SI (PSIG x SI) has an f^2 of 0.024. According to Kenny's criteria, this is close to the large category for moderation effects (≥ 0.025), and can be interpreted practically as having a nearly substantial moderating effect. Hence, service innovation emerges as the primary predictor of academic quality, while sustainable governance principles strengthen this impact directly and through moderation. Improving academic quality in private universities should therefore be supported not only by responsive service innovation but also by sustainable, consistent, and adaptive governance practices.

Significance (Hypothesis Testing)

Significance testing in PLS-SEM determines whether the relationships between latent variables in the model are statistically significant. Bootstrapping is used to calculate path coefficients and standard errors. The results are expressed as t-statistics or p-values. A relationship is considered statistically significant if the p-value is less than the predefined significance level (0.05 in this study). Significant path coefficients indicate strong statistical support for the hypothesized relationships.

Table 9. Bootstrapping results – direct effects

Path	OS	Sample Mean	Std. Dev.	T Statistics	P Values	Results
SI → AQ	0.482	0.480	0.048	10.105	0.000	Significant
PSIG → AQ	0.349	0.350	0.047	7.340	0.000	Significant
PSIG x SI → AQ	0.081	0.080	0.026	3.110	0.002	Significant

OS: Original Sample Source: SEM-PLS Analysis Results (2025)

The bootstrapping analysis confirms that all tested paths significantly affect the endogenous variable Academic Quality.

Impact of Service Innovation (SI) on Academic Quality (AQ)

Service innovation has the strongest influence on academic quality, with a path coefficient of 0.482. The T-statistic of 10.105 and p-value of 0.000 show high statistical significance. This finding supports that innovation in educational services is a key determinant in enhancing students' perception of academic quality. With an effect size f^2 of 0.264 (medium effect), service innovation has a meaningful and substantial role. Improvements in service innovation will have a tangible and measurable impact on academic quality.

Examples include the use of interactive learning methods, technology integration in teaching, and responsive administrative services. For instance, a user-friendly learning management system (LMS) can enhance access to learning materials, improve communication with lecturers, and streamline assignments ultimately boosting perceived academic quality. This aligns with Rogers' Diffusion of Innovation theory, which states that proper adoption and implementation of innovation can provide competitive advantage and performance enhancement.

Impact of Principles of Sustainable Innovation Governance on Academic Quality

PSIG also has a positive and statistically significant effect on academic quality, with a path coefficient of 0.349 (T-statistic = 7.340, p-value = 0.000). While not as strong as SI, it remains an important factor. The f^2 effect size of 0.140 indicates a small effect, yet still meaningful especially considering governance serves as the foundation for organizational operations. PSIG includes aspects like consistency in policy implementation, long-term commitment to innovation, effective communication, coordination, collaboration, cooperation, and creative problem-solving.

When applied consistently, these governance principles help establish a sustainable ecosystem for academic quality enhancement. For example, maintaining consistent academic standards across study programs ensures quality learning experiences, while long-term faculty development supports better teaching and research. Effective communication across university departments improves program execution, and productive collaboration among faculty, staff, and students creates a dynamic learning environment.

Moderating Effect of PSIG on the Relationship between SI and AQ

Moderation analysis shows that PSIG strengthens the effect of SI on AQ. The interaction coefficient is 0.081 (T-statistic = 3.110, p-value = 0.002), confirming the statistical significance of this moderating role. The effect size for moderation

($f^2 = 0.024$), though slightly below the threshold for a large effect (0.025), is practically close to substantial. This suggests that combining innovation with sustainable governance creates a synergistic effect that enhances academic quality more than each factor individually.

This means universities cannot rely solely on service innovation without solid governance systems and vice versa. Integration of both is essential. For example, implementing an innovative online learning system requires not just good technology, but also governance support like continuous training for lecturers, responsive technical support, systematic evaluation, and leadership commitment to ongoing development. Without good governance, even excellent innovations may fail.

Theoretical Contribution

This study provides a significant contribution to the enrichment of the Diffusion of Innovation theory (Rogers, 2003) in the context of higher education. First, the findings confirm that service innovation exerts a dominant influence on academic quality, with the strongest path coefficient ($\beta = 0.482$; $f^2 = 0.264$, medium effect size). This extends the understanding of diffusion of innovation theory by demonstrating that the successful adoption of innovation in higher education is not only shaped by the five intrinsic attributes of innovation (relative advantage, compatibility, complexity, trialability, and observability) but is also strongly determined by extrinsic institutional readiness factors, such as policy pressures, infrastructure availability, institutional ecosystems, and human resource capacity.

Second, this study advances the diffusion of innovation theory by incorporating sustainable innovation governance principles as a moderating variable that strengthens the impact of service innovation on academic quality ($\beta = 0.081$; $T = 3.110$; $p = 0.002$). The integration of sustainable innovation governance principles dimensions including commitment, consistency, communication, coordination, collaboration, cooperation, and creativity, demonstrates that innovation diffusion in higher education cannot be fully understood solely from an individual adoption perspective, but must also be viewed as an institutional process requiring long-term governance support. Accordingly, the diffusion of innovation theory, which originally emphasized individual perceptions of innovation, is broadened to encompass sustainable institutional governance factors.

Third, the study provides empirical evidence of a synergistic effect between service innovation and sustainable innovation governance principles, whereby academic quality improves to a greater extent than when each factor operates independently. This underscores that, in the context of higher education, diffusion of innovation should be understood not merely as the adoption of new technologies or approaches, but also as an institutional process that requires systemic support to ensure that innovations deliver sustainable improvements in academic quality. Thus, this study contributes to a new understanding of innovation diffusion in higher education as an integrative process between innovation factors and sustainable institutional governance to achieve optimal academic outcomes

Conclusion

The findings confirm that all three proposed hypotheses are statistically supported. Service innovation and sustainable innovation governance, both independently and interactively, contribute significantly to improving academic quality in private universities. Theoretically, these findings enrich the diffusion of innovation theory by demonstrating that its application in higher education becomes stronger when combined with sustainable governance principles. Practically, they offer a foundation for university management to integrate innovation with adaptive, visionary governance systems. Limitations of the study include its local scope, as it only involved private universities in Gorontalo. Thus, generalizability is limited. Also, the quantitative approach may not fully capture the contextual and subjective aspects of service innovation at the institutional level. Future studies are recommended to broaden the geographic scope, include more diverse respondents, and adopt qualitative approaches to capture the nuanced dimensions of sustainability in educational innovation governance.

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