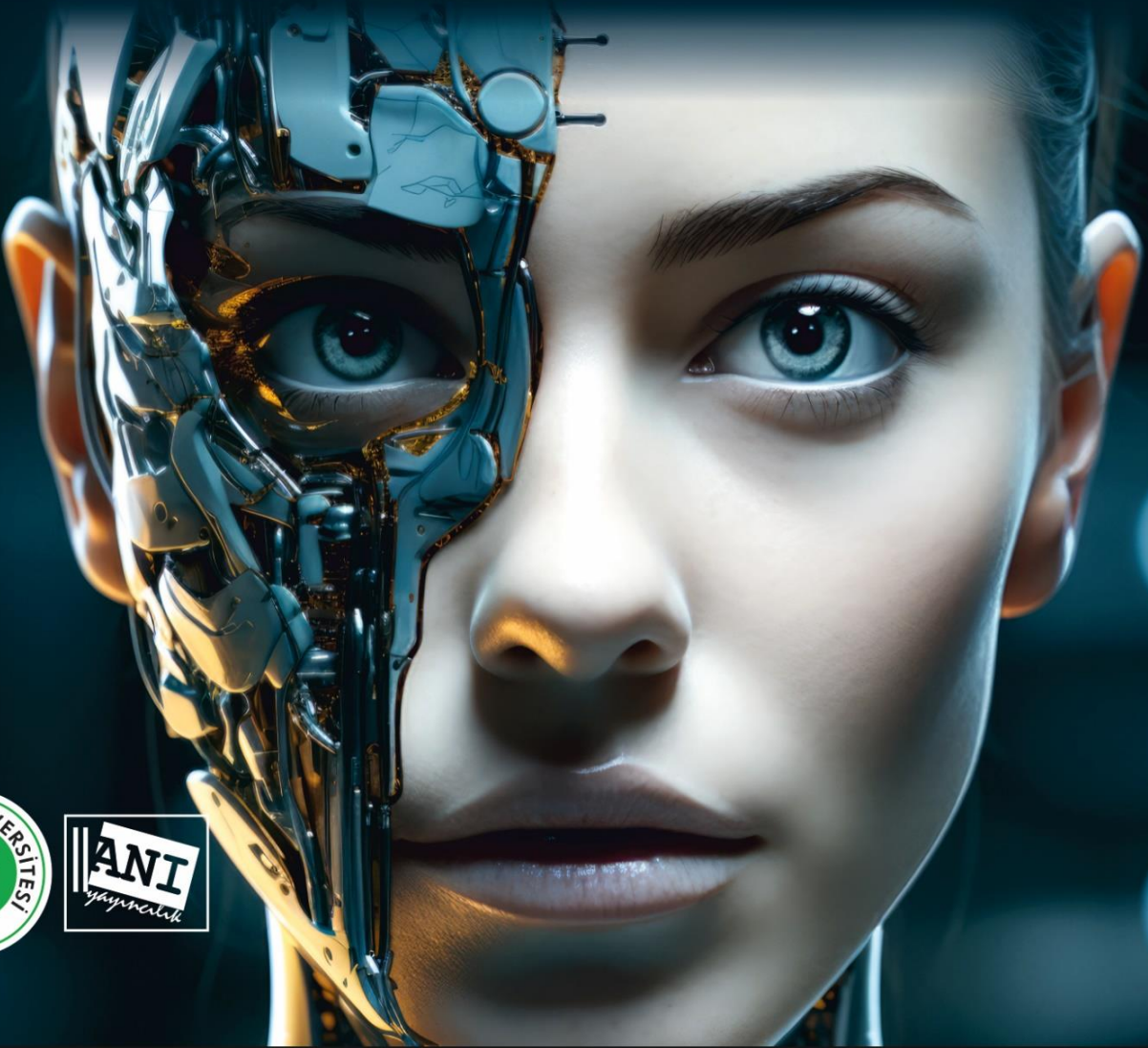# INTERNATIONAL EJER CONGRESS
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XI International Eurasian Educational Research Congress

CONFERENCE PROCEEDINGS

XI INTERNATIONAL EURASIAN

EDUCATIONAL RESEARCH CONGRESS

EJERCONGRESS 2024
CONFERENCE
PROCEEDINGS

May 21-24, 2024/ Kocaeli University - Türkiye

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Main Theme

"Designing the Future: Changing Paradigms and Transhumanism with Artificial Intelligence in Education"

Sub-Themes

- Academic freedom, autonomy, and social responsibility in education
- Artificial intelligence and educational applications
- Augmented reality applications
- Barriers to learning
- Blended learning
- Computer-assisted measurement and evaluation
- Core skill sets for students and teachers
- Design of school buildings in the future
- Designing and delivering a digital strategy
- Digital competence
- Digital parenting
- Distance Education
- Earthquake Education
- Post Earthquake Trauma Training
- Earthquake and Effective Psychosocial Intervention Methods
- Earthquake and Trauma
- The Impact of Earthquakes on School Staff
- Education and society
- Education for healthy living and healthy communities
- Education for a sustainable life
- Education in the digital age: Primary, secondary, high school, higher education, and application examples
- Educational leadership in the digital age
- Effects of regional differences on education
- Equity, Diversity, and Inclusion Related to Marginalized Groups
- Emergency Management at Schools
- Evidence-Based School Counseling Services for Refugees and Marginalized Groups
- Globalisation and Education
- Higher education
- Innovative learning designs for student success
- Instructional technologies in the digital age
- Integration of immigrants into education
- K-12 education (preschool, primary, and secondary education)
- Learning management systems
- Lifelong learning
- Machine learning
- Management information system
- Managing schools
- Measurement and evaluation of students' learning outcomes
- Metaverse
- Migration and education
- Multicultural Classroom Concerns of Educators and Parents
- New educational system after COVID-19
- New skills to live and work in new times
- New technologies in teaching and learning

- New trends in educational research
- New trends in learning and teaching methods
- New trends in research methods
- Pedagogy, educational programs, and teaching
- Politics, good governance, and leadership in the educational sector
- Program design and development
- Promoting equality, diversity, and inclusion
- Psychological counseling and guidance in education
- Quality assurance/standards and accreditation
- Research and innovations in education
- Research ethics
- Right to an education
- Sustainable Educational Goals Related to Refugees
- Teacher education in the digital age
- The Possibility of Fundamental Changes in the Curriculum
- The role of parents in education
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This book has been compiled with contributions from 61 authors representing 35 different universities in Turkiye, the United States, and Iran, as well as Turkiye's Ministry of National Education. Among the contributors, there are 51 authors from 31 universities 6 authors from education institutions in Turkey, 3 authors from 2 universities in the United States, and 1 author from a university in Iran.

CONTENTS

Subitizing in Preschool Education: A Bibliometric Analysis

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Abstract

Subitizing is the ability to identify the number of objects without counting them. This skill naturally emerges at a very early age, but it further develops when supported. In parallel, research has shown that it supports other cognitive skills along with early math skills. For this reason, it is important to identify studies in the literature to determine the subitizing levels of preschool children and provide example practices to help teachers support these children. This study examines the trends and distributions of research on subitizing skills of preschoolers, as indexed in the Web of Science. Studies dating back to 1978 have shown an increasing trend over time, although their numbers are still limited. Subitizing in preschool has become a subject of interest in many countries, especially in the USA, and has recently spread to other countries such as Spain, Canada, and China. It has been determined that most of these studies are conducted in the fields of psychology and education, and are associated with various mathematical skills, including counting, number line estimation, number sense, arithmetic units, and the principle of cardinality. It was observed that the majority of the studies (n=40) were indexed in the Social Sciences Citation Index (SSCI). Furthermore, the overwhelming majority of the publications were in English (n=45) and published in the USA (n=22). Recently, studies have also begun in countries such as China, Singapore, Australia, and Sweden.

Introduction

Early childhood education lays the foundation for various cognitive skills, including the essential mathematical ability known as subitizing. Subitizing is the ability to identify the number of objects without counting them (Sarama & Clements, 2009). Subitizing, defined as distinguishing quantities by sight, differs from counting, which involves matching objects with consecutive natural numbers (Mandler & Shebo, 1982). It consists of two dimensions: perceptual and conceptual subitizing. Perceptual subitizing is the instant recognition of a number and then naming it (Clements, 1999), while conceptual subitizing involves perceptually identifying the small groups that make up the whole and then expressing the total quantity (Sarama & Clements, 2009). In other words, perceptual subitizing is performed with small numbers, while conceptual subitizing allows for the recognition of larger numbers.

Subitizing is a skill that is acquired and developed with age and development. Research shows that 6-month-old infants can subitize up to three objects (Antell & Keating, 1983; Clements, 1999; Starkey et al., 1990); 4-year-old children can subitize up to four objects (Starkey & Cooper, 1995); and 5-year-old children can subitize up to six objects (Sarama & Clements, 2009). This skill supports the development of many early mathematics skills (Olkun & Özdem, 2015; Olkun et al., 2015), such as understanding part-whole relationships (Clements, 1999), understanding, representing, and associating numbers (Jung, 2011), and contributes to primary school mathematics performance (Gray & Reeve, 2014; Hannula-Sormunen et al., 2015). Therefore, this skill should be supported by individuals responsible for the child's development and education.

This research aimed to determine the trends and publication frequencies of studies on subitizing in preschool. A bibliometric analysis of academic studies was conducted. Based on this analysis, the scope of the studies published on subitizing skills in preschool was determined, and the results are expected to inform future research. The research questions of the study are as follows:

1. What is the distribution of studies on subitizing skills in preschool within the Web of Science database?

   a. What is the distribution of studies according to their research areas?

   b. What is the distribution of studies according to the index in which they were published?

   c. What is the distribution of studies according to the year of publication?

   d. What is the distribution of studies according to the countries where they were conducted?

   e. What are the most recurring words in the keywords of the studies?

   f. What is the distribution of studies according to the journal in which they were published?

2. What are the citation rates of studies on subitizing skills in preschool within the Web of Science database?

   a. What is the distribution of studies according to the years of citation?

b. What is the distribution of studies according to the countries where they are cited?

Method

Research Design

The bibliometric analysis method was used in the current research. Bibliometric analysis is a method that quantitatively evaluates the output of a particular research topic over a specific period of time (Donthu, 2021). It facilitates understanding scientific discoveries and research trends, identifying interdisciplinary relationships and measuring scientific interactions, making scientific decisions, evaluating academic performance, and formulating research policies. For these reasons, this analysis method was preferred for examining scientific articles on preschool children's subitizing skills.

Research Sample

The criterion sampling method was used to select the studies in this research. Criterion sampling involves examining situations, people, or events that meet predetermined criteria (Patton, 2021). In the current study, scientific articles published in the indexes on the Web of Science were selected based on specific criteria. There was no time limitation for the research conducted in this field, and the last access date was January 16, 2024. To access all the data in detail, an advanced search was performed using the terms ALL=("subitizing" or "subitize" or "subitise" or "subitising") AND ALL=("kid" or "infant" or "infancy" or "toddler" or "young children" or "preschooler" or "preschool" or "pre-school" or "kindergarten"). As a result of this search, 48 studies were identified.

Data Analysis

Bibliometric mapping analysis was used for data analysis in the study. This analysis method is used to understand scientific discoveries and research trends, identify interdisciplinary relationships, and measure scientific interactions. Bibliometric analysis plays an important role in many areas such as making scientific decisions, evaluating academic performance, and formulating research policies. VosViewer software was used to perform bibliometric analysis. The data, full records, and cited references of the retrieved studies were downloaded in tab-delimited (Win) file format.

Results

The distribution of studies on subitizing skills in preschool education, which are included in the Web of Science international database, by publication year is presented in Figure 1:

Figure 1

Distribution of Studies on Subitizing in Preschool Period According to Years
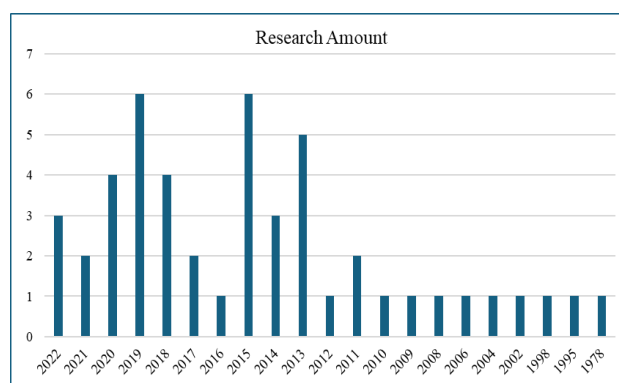
When the results of the research were examined, it was seen that the studies on subitizing in preschool in the Web of Science database have been conducted since 1978. Studies were not consistently conducted annually until 2011, with only one study published per year. Although the number of studies increased starting from 2013, there have been no more than six studies published annually, which were in 2015 and 2019. The distribution of the mentioned studies by publication language, research areas, publication index, and the country where the research was conducted is shown in Table 1:

Table 1

Distribution of Studies on Subitizing in Preschool Period by Various Variables

Variables	Categories	n	%
Research Areas	Psychology	32	66,67
	Education	21	43,75
	Rehabilitation	2	4,17
	Computer Science	1	2,08
	Life Sciences Biomedicine Other Topics	1	2,08
	Neurosciences Neurology	1	2,08
	Physiology	1	2,08
	Public Environmental Occupational Health	1	2,08
The index	Social Sciences Citation Index (SSCI)	40	83,33
	Emerging Sources Citation Index (ESCI)	8	16,67
	Science Citation Index Expanded (SCI-EXPANDED)	8	16,67
Language	English	45	93,75
	Spanish	2	4,17
	German	1	2,08
Country	USA	22	45,83
	Belgium	5	10,42
	England	4	8,33
	Sweden	4	8,33
	Australia	3	6,25
	Germany	3	6,25
	Netherlands	3	6,25
	Spain	3	6,25
	China	2	4,17
	Singapore	2	4,17
	Others	8	16,66

It has been determined that most of the studies are conducted in the fields of psychology (n=32 and education (n=21). It was observed that the vast majority of the studies (n=40) were indexed in Social Sciences Citation Index (SSCI); the number of studies in Emerging Sources Citation Index (ESCI) and Science Citation Index Expanded (SCI-EXPANDED) was quite low (n=8 for each).

A significant portion of the studies were conducted in the USA (n=22), and consequently, they were predominantly published in English (n=45). However, studies on subitizing skills in preschool education have also been conducted in several other countries, including Belgium (n=5), England (n=4), and Sweden (n=4). The countries in which the conducted studies were carried out in collaboration are shown in Figure 2:

Figure 2

The Distribution of Joint Studies on Subitizing in Preschool Period According to Countries
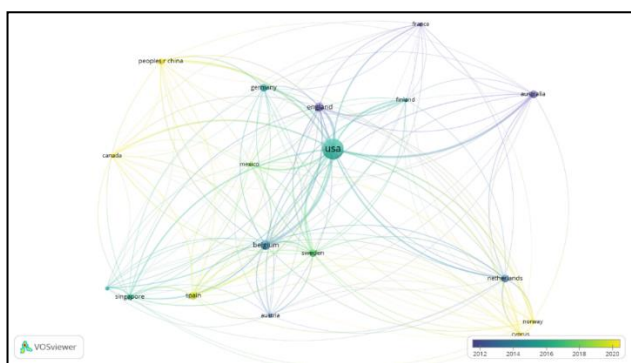
The studies, while centered in the USA, have been conducted in collaboration with countries such as Australia, Belgium, the Netherlands, Singapore, England, and Germany. Examining the trends over the years, it is noticeable that in recent years, collaborations have increasingly included countries such as Spain, Canada, China, Norway, and Cyprus.

Figure 3

Distribution of Studies on Subitizing in Preschool Period According to Keywords
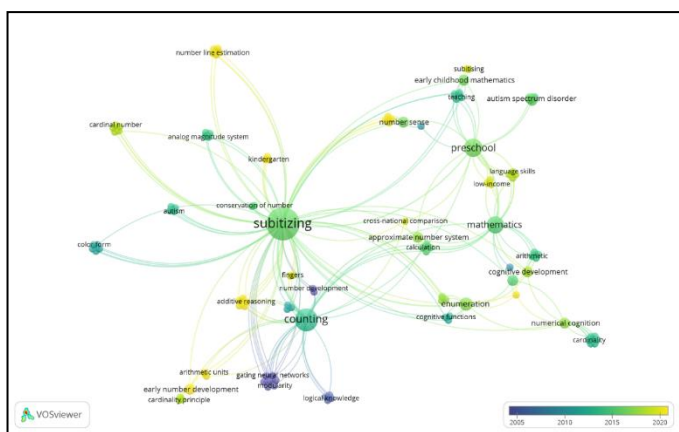

When examining the keywords of the studies, it is observed that concepts such as mathematics, counting, preschool,

preschool mathematics, and cardinality are frequently encountered. Trends over the years reveal that while keywords such as number development, logical knowledge, and modularity appeared in the early 2000s, more recent years have seen the emergence of concepts like arithmetic units, additive reasoning, number line estimation, and language skills.

The distribution of the journals in which the mentioned studies were published and the preferred journals over time are shown in Figure 4.

Figure 4

Distribution of Journals in Which Studies on Subitizing in Preschool Period were Published According to Years
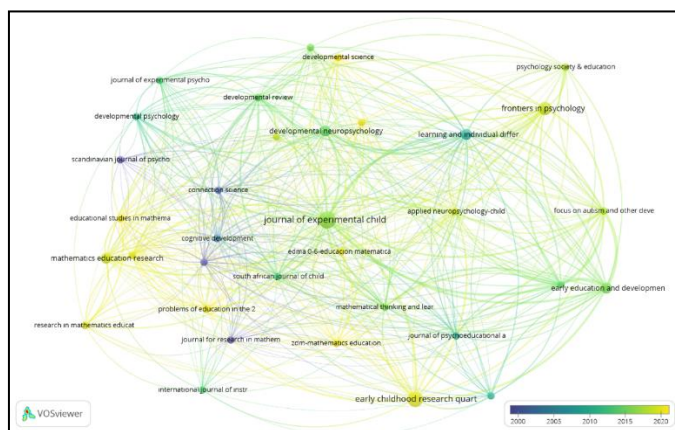

The studies have been published in a variety of journals. According to Figure 4, the most frequently preferred journals include the Journal of Experimental Child, Frontiers in Psychology, and Early Childhood Research Quarterly. In recent years, in addition to Frontiers in Psychology and Early Childhood Research Quarterly, journals such as Mathematics Education Research, Research in Mathematics Education, and ZDM-Mathematics Education have also been preferred.

The findings related to the citations of the studies are presented in Figures 5 and 6. Figure 5 shows the findings on the levels of citations received, while Figure 6 visualizes the distribution of citing countries over the years.

Figure 5

Distribution of the Number of Citations of Studies According to the Year of Publication
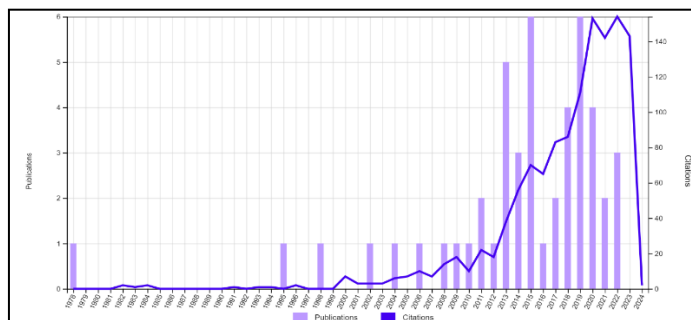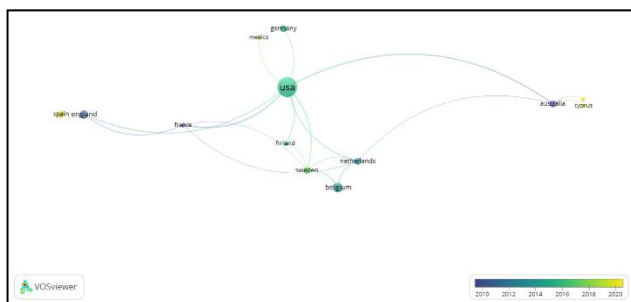

The citation levels of the studies have been determined to increase in parallel with their publication years (see Figure 5).

Additionally, the years with the highest number of citations are 2020 and 2022, each with 6 citations.

Figure 6

Distribution of the Most Cited Studies by Country

The countries citing these studies include Spain, England, France, Finland, Sweden, Belgium, the Netherlands, Mexico, Germany, Australia, and Cyprus. In recent years, Spain and Cyprus have been particularly prominent in citing these studies.

Discussion, Conclusion, and Recommendations

Subitizing, the ability to instantly recognize the number of objects in a set without counting, is a fundamental skill that emerges naturally in early childhood. This cognitive skill plays a critical role in the development of early math skills and more advanced mathematical concepts, and overall numerical literacy (Clement, 1999). In this study, which examines the research conducted on subitizing skills that are crucial for a child's development during the preschool period, it has been revealed that the vast majority of the studies have been conducted in the fields of psychology and education. Upon examining the keywords that provide information about the focus of the research and the associated concepts and skills, it was found that subitizing skills are frequently associated with abilities such as counting, cardinality, number development, logical knowledge, arithmetic units, additive reasoning, and number line estimation. This finding aligns with other research in the literature, which discusses the impact of subitizing skills on these related skills (e.g. Gray & Reeve, 2014; Hannula-Sormunen et al., 2015; Jung, 2011; Olkun & Özdem, 2015; Olkun et al., 2015).

Upon examining the research results, it was found that studies on subitizing in preschool within the Web of Science database have been carried out since 1978. Until 2011, only one study was conducted annually, and afterward, the number of studies per year began to increase. Although it was determined that the highest number of studies were conducted in 2015 and 2019, this number is still quite low (n=6). In parallel, the number of citations to studies began to increase after 2012, with a notable rise in the number of citations in 2020 and 2022. Nevertheless, this finding indicates that researchers are increasingly interested in subitizing skills in preschool children. At this point, it is important to promote and increase the visibility of these studies to encourage more research on that subject.

The majority of these studies are indexed in the Social Sciences Citation Index and have been published in a variety of journals, such as the Journal of Experimental Child Psychology, Frontiers in Psychology, Early Childhood Research Quarterly, Mathematics Education Research, Research in Mathematics Education, and ZDM-Mathematics Education. The fact that these journals are published in English directly influences the language of the studies. This can be attributed to the scope and article acceptance criteria of the journals indexed in the Web of Science. In addition to the language of the journals, the country where the study is conducted also affects the language of the research. Although there have been studies conducted in countries like Belgium, China, and Sweden, the majority of the studies included in the research were carried out in the USA. Since English is accepted as the international language, this allows the dissemination of research findings worldwide, enabling caregivers, educators, and other professionals involved in child development and education to benefit from them. The findings indicate that research has been conducted in collaboration with countries such as Australia, Belgium, the Netherlands, Singapore, England, Germany, Spain, Canada, China, Norway, and Cyprus. Similarly, these countries are also the ones that most frequently cite the studies. This highlights the attention many countries are giving to subitizing skills in preschool children and raises awareness about supporting these skills. Nevertheless, to ensure equal opportunities for all children, it would be beneficial for other countries around the world to also engage in research on this important skill.

Based on the findings of the research, the following recommendations can be made:

- Considering the limited number of studies on subitizing skills in preschool, the number of studies determining children's subitizing skill levels can be increased.

- Research on subitizing in the preschool period can be conducted in different countries, thereby increasing sample diversity.

- Collaborative studies involving different countries and comparing results can be conducted.

- Research on subitizing skills in preschool can be analyzed in various other databases to determine trends and distributions.

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