Journal of Teacher Education and Lifelong Learning (TELL)

Volume: 5 Issue: 1 Year: 2023 Research Article ISSN: 2687-5713

The Use of Literary Elements in Teaching Mathematics: A Bibliometric Analysis

Burcu Durmaz

[1] Süleyman Demirel University, School of Education, Mathematics and Science Education Department, Isparta, Turkey
drburcudurmaz@gmail.com

Article Info

Article History
Received: 01/11/2022
Accepted: 04/04/2023
Published: 30/06/2023

Keywords:
Bibliometric Analysis, Disciplinary Literacy, Literary Elements, Mathematics Education.

ABSTRACT

Utilizing literary elements for teaching mathematics is gaining importance nowadays because it is claimed that integrating literature and mathematics supports learning process in different ways. Before using this integration in educational settings, we, teachers, and researchers, need to know that what the research tell us about this integration. Therefore, the goal of this research is to review the literature on literary elements employed in mathematics instruction. In order to accomplish this, a literature search covering the years 1951-2021 was conducted using subject-related keywords including "children's literature," "story," and "mathematics." The studies obtained from the journals which are indexed in the Scopus using the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) diagram. The studies about the topic were investigated in terms of title, keywords, and abstracts before the analysis. As a result, 484 articles that met the inclusion criteria of the research were investigated by bibliometric and descriptive analysis. The most influential authors, articles, journals, institutions, the trend of the publications by years, cooperation between institutions and cooperation between authors were determined. As a result, this study has revealed the conceptual, intellectual, and social structure of the literary elements used in mathematics instruction.

Citation: Durmaz, B. (2023). The use of literary elements in teaching mathematics: A bibliometric analysis. *Journal of Teacher Education and Lifelong Learning*, *5*(1), 152-172.

INTRODUCTION

It is well recognized that teaching early language and literacy skills with mathematics fosters the development of each of these skills (Altındağ Kumaş, 2022). For this aim, children's literature and mathematics may be combined to assist both fields. Because children's literary elements such as picture books offer more experience comparison to textbooks (Burns & Silbey, 2000) and using these elements in the classroom is one of the best teaching approaches (Acer & Gözen, 2020). Also, including these elements like picture books and stories in the classroom enhances and differentiates mathematics instruction while considering the unique needs of each student (Forbringer et al., 2016). Thus, integrating children's literary elements into mathematics, can support high levels of interaction between teachers and students (Kaya & Haydar, 2021).

This teaching approach, which integrates of mathematics and literature content areas, not only contributes to students but also teachers in various ways (Edelman et al., 2019). According to literature, the use of literary elements in mathematics teaching provides the presentation of mathematical concepts in a (real life) context, making mathematical connections, developing mathematical language, and cognitive and affective processes related to mathematics (Columba et al., 2005; Green, 2013; Hassinger-Das et al., 2015; Lemonidis & Kaifa, 2019; Mink & Fraser, 2005). However, there are also studies that draw attention to the need to be cautious in some respects against such an approach (Forbringer et al., 2016; Nurnberger-Haag et al., 2020a). Because literary elements like picture books that are used to teach mathematics may not always achieve the needed standards because they could contain misconceptions and ignore the students' developmental processes that must be considered when teaching a mathematical subject like numbers or numeracy (Nurnberger-Haag, 2017; Powell & Nurnberger-Haag, 2015; Ward et al., 2017). So, the characteristics of the teachers who would implement the integration in their classrooms, as well as the choice of literary elements to be used, play a significant part in this method, where the two curriculum areas are combined. Researchers investigate this topic to learn more about pre-service and in-service teachers' competencies, beliefs, and classroom behaviors related to this approach (Cooper et al., 2020; Farrugia & Trakulpdetkrai, 2020; Prendergast et al., 2019; Rogers et al., 2015). These findings reveal that while though pre-service and in-service teachers have similar ideas about the context and they conduct their lessons similarly, they also have misconceptions like this approach is generally for kids not all students from all ages and it's not appropriate for teaching all areas of mathematics (Larkin & Trakulphadetkrai, 2019; Trakulphadetkrai, 2018). In-service teachers may be less hesitant to incorporate literary aspects into mathematics lessons because of these assumptions. The development of these views may have been influenced by investigations done mostly with young children and in the setting of mathematics (Edelman et al., 2019). Whereas using children's literary elements in mathematics teaching has many potentials in the context of teacher education (Can et al., 2020; Durmaz, 2022; Ginsburg & Uscianowski, 2017; Jett, 2018). Because this integration helps to increase teachers' self-efficacy in mathematics and encourages them to design innovative mathematics lessons (Jett, 2018), which is one of the important goals of a constructivist curriculum. However, research indicates that pre-service and/or in-service teachers benefit from this integration in a limited way (Rogers et al., 2015). So much so that while they rarely utilize this approach to teach a new concept or problem-solving, which are effective ways of integrating, they often care about the relavance of the book to the subject rather than the quality of the book and have lack of noticing the mathematical context of the book (Cooper et al., 2020; Prendergast et al., 2019). However, a considerable number of studies indicate that no curriculum can achieve its goal without teachers.

Whatever the reason, it is believed that it is vital to look at the studies on the subject from a wider angle since teachers may be preventing students from benefiting from this approach, which can enrich and distinguish mathematics classes. Because it is well recognized that teachers' views have a direct impact on how they teach (Staub & Stern, 2002). Based on these factors, the objective of this study is to expose the conceptual, social, and intellectual framework of the literature on the use of literary elements in mathematics instruction. It would therefore help move future research on the subject and teaching

methods forward by providing a general framework for studies on the subject.

Literature Review

In the literature, studies on using literary elements in mathematics can be classified as those carried out with students at different educational levels, parents and/or caregivers, pre-service and in-service teachers, investigating some characteristics of children's literary elements in scope of mathematics, experimental studies, and reviews (such as systematic review, meta-analysis, and bibliometric analysis etc.).

Most of the studies are conducted with kindergarten and pre-school students (Björklund & Palmér, 2020; Björklund & Palmér, 2022; Capraro & Capraro, 2006; Casey et al., 2004; Casey et al., 2008; Elia et al., 2010; Green et al., 2018; Hassinger-Das et al., 2015; Hong, 1996; McGuire et al., 2020; Purpura et al., 2017; Purpura et al., 2021; Rathé et al., 2016; Segal-Drori et al., 2018; Skoumpourdi & Mpakopoulou, 2011; Van den Heuvel-Panhuizen et al., 2009; Van den Heuvel-Panhuizen & Van den Boogaard, 2008; Van den Heuvel-Panhuizen et al., 2011; Van den Heuvel-Panhuizen et al., 2016; Wijns et al., 2022; Young-Loveridge, 2004), and some of them are conducted with primary school students (Cooper et al., 2011; Lemonidis & Kaifa, 2019; McAndrew et al., 2017; Mink & Fraser, 2005; Russo et al., 2021), and middle school students (Durmaz & Miçooğulları, 2021; Günbaş, 2015; Yalçın et al., 2022). Since the focus of research with pre-school or kindergarten children is about early mathematics, studies with parents are also conducted (Gaylord et al., 2020; Godwin et al., 2016; Goldstein et al., 2016; Uscianowski et al., 2020), and some of these studies focus on parent-child interaction in the process of reading books about mathematics (Hendrix et al., 2019; Hojnoski et al., 2014; Vandermaas-Peeler et al., 2009).

There are also many studies carried out with pre-service and in-service teachers. In studies in which pre-service teachers are the participants of the research, usually (Can et al., 2020; Durmaz, 2022; Edelman, 2017; Harding et al., 2017; Jett, 2014; Leonard et al., 2014; Livy et al., 2021; Nesmith et al., 2017; Nurnberger-Haag et al., 2020b; Nurnberger-Haag et al., 2021b; Prendergast et al., 2019; Purdum-Cassidy et al., 2015; Rogers et al., 2015; Wheeler & Mallam, 2020) are examined the beliefs and opinions of pre-service and in-service teachers towards this integration, analyzed integrated activities and lesson plans with children's literary elements or focused on teacher education/professional development. The studies carried out with in-service teachers mostly deal with their views and experiences related to children's literary elements and mathematics integration (Can & Durmaz, 2023; Cotti & Schiro, 2004; Farrugia & Trakulpdetkrai, 2020; Hojnoski et al., 2016; Jett, 2018; Livy et al., 2021; Prendergast et al., 2019; Stites et al., 2020; Toh et al., 2017; Yang et al., 2022).

Research aimed at examining literary elements, which are as important as pre-service and in-service teachers in the integration process, is aimed at investigating the selected books' characteristics in the context of a specific topic such as numbers and geometry (Darragh, 2018; Fellus et al, 2022; Nesmith & Cooper, 2010; Nurnberger-Haag, 2017; Nurnberger-Haag et al., 2020a; Splinter et al., 2022; Van den Heuvel-Panhuizen & Elia, 2012; Ward et al., 2017), setting out the various field-specific guidelines or criteria for selecting qualified books for integration, and potential misconceptions that literary elements may include (Nurnberger-Haag et al., 2020a; Nurnberger-Haag et al., 2021a; Powell & Nurnberger-Haag, 2015; Van den Heuvel-Panhuizen & Elia, 2012).

Finally, there are experimental studies also related to the subject (Edelman et al., 2019). In these, it is seen that the effects of instructional interventions like early intervention or techniques such as interactive reading are employed, and their effects are reported. Some of the variables discussed in these experimental studies are verbal problem-solving ability (Günbaş, 2015), modeling ability (Wijns et al., 2022), mathematics performance (Van den Heuvel-Panhuizen et al., 2016), performance on length measurement (Van den Heuvel-Panhuizen et al., 2011), arithmetic/mathematical achievement/knowledge (Jennings et al., 1992; Purpura et al., 2017; Purpura et al., 2021), interest in mathematics (Jennings et al., 1992), using mathematical words and/or mathematical language (Jennings et al., 1992; Purpura et al., 2017; 2021), success about fraction concept (Lemonidis & Kaifa, 2019), and attitude towards geometry (McAndrew et al., 2017).

There are also reviews about this topic (Edelman et al., 2019; İnal-Kızıltepe, 2018; Op't Eynde et al., 2022b; Powell & Nurnberger-Haag, 2015) because the body of the literature about the topic has some mixed results (Edelman et al., 2019). So, some researchers conducted these kinds of studies to see the landscape of using literary elements in education and mathematics. For example, Zhang et al. (2023) aimed to examine the experimental studies on the subject, they investigated the articles published between 2000-2022. They included the studies which are indexed in EBSCO, Education Research Complete, JSTOR and Springer. They found out that a large part of the studies was related to the early childhood mathematics and there are very limited studies on high school students. Edelman et al., (2019) also examined empirical studies which were published between 1991-2016 in their meta-analysis. They used ERIC, EBSCOHOST and Google Scholar for literature review and used "children's literature" and "mathematics" keywords. Edelman et al. (2019) also figured out that empirical studies on this topic is quite few. When they analyzed these (n=23) experimental studies, they figured out that the studies were carried out under the titles of student success, motivation and engagement, mathematical discourse, and pre-service/in-service teacher education. They underlined the need of the studies which are focus on mathematics success, making international comparisons and conducting studies with a wider age range. Finally, Arizpe (2021) conducted a study in which she evaluated the studies on children's picture books between 2010-2020. To the best of our knowledge, there is no bibliometric analysis about the topic. In fact, there is limited study using bibliometric tools in mathematics education (Drijvers et al., 2020).

It has been determined that bibliometric studies, which is one of the powerful systematic review tools, conducted specifically on mathematics education are carried out on a general topic such as mathematics education or specific issues such as number sense, mathematics anxiety, instrumental orchestration, ICT in mathematics education, problem solving, primary school mathematics education (Drijvers et al., 2020; Ersözlü & Karakuş, 2019; Gökçe & Güner, 2021; Güner & Gökçe, 2021; Jiménez-Fanjul et al., 2013; Kılıç, 2023; Özkaya, 2018; Ramirez & Rodriguez Devesa, 2019; Suseelan et al., 2022; Trinh Thi Phuong et al., 2022). So, no studies related to the research topic have been encountered. For example, Wu (2018) examined the research on children's picture books without any distinction about content areas. He analyzed a total of 286 articles published between 1993 and 2015, which he obtained because of his search in Web of Science (WOS), with HistCite software. Wu (2018) used only "picture book" and "picturebook" as keywords in his study focused on bibliometric analysis and presented a more general perspective on the studies about children's picture books.

As can be seen, the studies on the subject were carried out in a way to cover certain years and keywords, while other studies were carried out in the context of meta-analysis and descriptive analysis. For this reason, it is thought that a more holistic perspective on the use of literary elements in mathematics education would be gained with the bibliometric analysis to be made within the scope of this study. Because bibliometric analysis is carried out by selecting the publications and selected keywords by the authors on this subject (Pring, 2015). Thus, in addition to the advantages of systematic review and meta-analysis studies, the change of the subject over time can be illustrated (Donthu et al., 2021), some predictions can be provided about future studies by connetting different publications related to the subject with the co-word analysis to be conducted (Marín-Marín et al., 2021), and it may be possible for interested researchers to notice research gaps in the subject (Chen et al., 2019). In light of this rationale, the following research questions were chosen:

1. How do the articles on the use of literary elements in mathematics teaching change according to the years they were published?
2. Which authors, articles, journals, institutions, and countries are the most influential in the studies on the use of literary elements in mathematics teaching?
3. Regarding the use of literary elements in mathematics teaching, what kind of intellectual, social, and conceptual structure emerges in terms of cooperation between countries, cooperation between authors and co-word network?

METHOD

Research Design

In this study, the use of literary elements in mathematics instruction was investigated using bibliometric analysis. Because systematic review studies like bibliometric analysis can be conducted in a way that is both more thorough and clearer (Andrews, 2005). Additionally, the linkages between any publication, author, or cited author with other publications and authors connected to the topic of interest can be shown through the maps produced as a result of the study (Zupic & Čater, 2015).

Research Instruments and Processes

The data were obtained through Scopus, among the international citation indexes or search engines Web of Science, Scopus, Google Scholar, Microsoft Academic and Dimensions (Moral-Muñoz et al., 2020). For this, first, in the Web of Science and Scopus indexes, which are two indexes where qualified international publications are indexed, initial search was made with the search code written based on the keywords used in the research on this subject. As more documents were reached in Scopus, the study was carried out on the articles in the Scopus index (Mongeon & Paul-Hus, 2016). Because in the first search using the same keywords, it was seen that there were more publications in Scopus than in WOS. Since Scopus is more comprehensive in terms of the relevant subject, the study was continued with it. A search was made for all times covering the date of 09/21/2021. Social Studies and Psychology filters were used because the studies that fit the scope of the study were not directly related to the field of educational sciences in the Scopus database and some studies on this subject were related to the field of psychology. The range of studies using literary elements such as children's picture books to many fields such as education, culture, psychology, and literature was effective in making this decision (Arizpe, 2021). The code used in the search is as follows:

TITLE-ABS-KEY ((math*ORgeom*ORcounting*) AND ("children's literature" OR "children's book" OR "picture book" OR "picturebook" OR "tradebooks" OR "trade book" OR "story book" OR "storybook" OR "stories" OR "storybase" OR "storyline" OR "storytell*" OR "shared book" OR "read-aloud" OR reading))

After this search code was applied, a total of 25,179 studies were reached. When the obtained studies were adjusted to be only articles according to the document type, they returned 17,213; 15776 when only in English publications are selected; when journal is selected as the source type, 15,406 articles remain. Finally, when Social Studies and Psychology filters were activated, 6885 articles remained. These articles were also re-examined in terms of the title of the publication and the abstracts to provide a more accurate result on the subject, so the data were extracted by excluding the articles that are not related to the subject. This was done to prevent the inclusion of irrelevant studies as a limitation of the bibliometric analysis (Zupic & Cater, 2015). The title and abstract were examined while performing the necessary data cleaning for studies that did not match the scope of the research (Le Thi Thu et al., 2021). Studies in which the keywords used during the data cleaning were used out of the scope of this research (for example, the use of the word story while explaining the narrative research methodology) were not included in the analysis. As a result, a total of 484 articles were included in the bibliometric and descriptive analysis. The approach used in the data collection phase is explained in the context of the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) (Pham et al., 2021) diagram (Fig. 1).

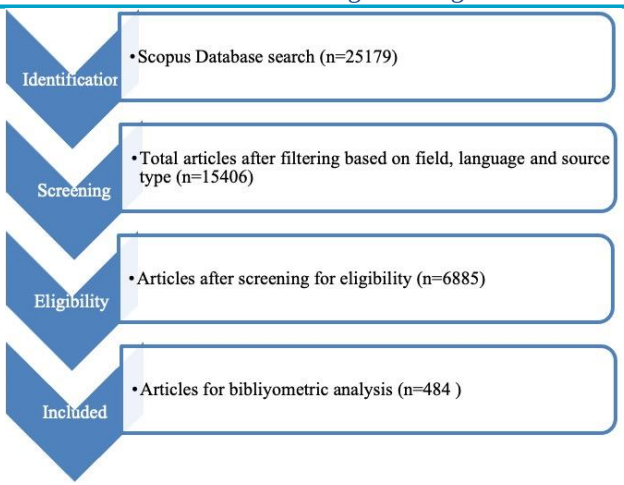

Figure 1. *PRISMA diagram for the study in SCOPUS database*

Data Analysis

Both descriptive statistics and bibliometric analysis were used to analyze the data. In this context, bibliometric analysis techniques were used to examine the distribution of studies on the use of literary elements in mathematics education by years, the top ten cited articles, the authors who contributed to the field and the number of publications, the active journals in this field, countries, and institutions. The determination of keyword analysis, source co-citation network analysis, and author co-citation network analysis was also made using collaborative network analysis. The package application VOSviewer (Version 1.6.9) (Van Eck & Waltman, 2010) was chosen as the analytical tool for cooperative network investigations.

Ethic

The "Higher Education Institutions Scientific Research and Publication Ethics Directive" was followed to the letter when conducting this study. No one engaged in any of the behaviors listed in the second section of the aforementioned regulation, "Actions Contrary to Scientific Research and Publication Ethics." Since the study used only publicly available materials and involved neither human data gathering nor any experimental procedures, it does not need permission from an ethics committee.

RESULTS

First, the distribution of 484 articles reached because of the review according to years was examined and presented in Figure 2.

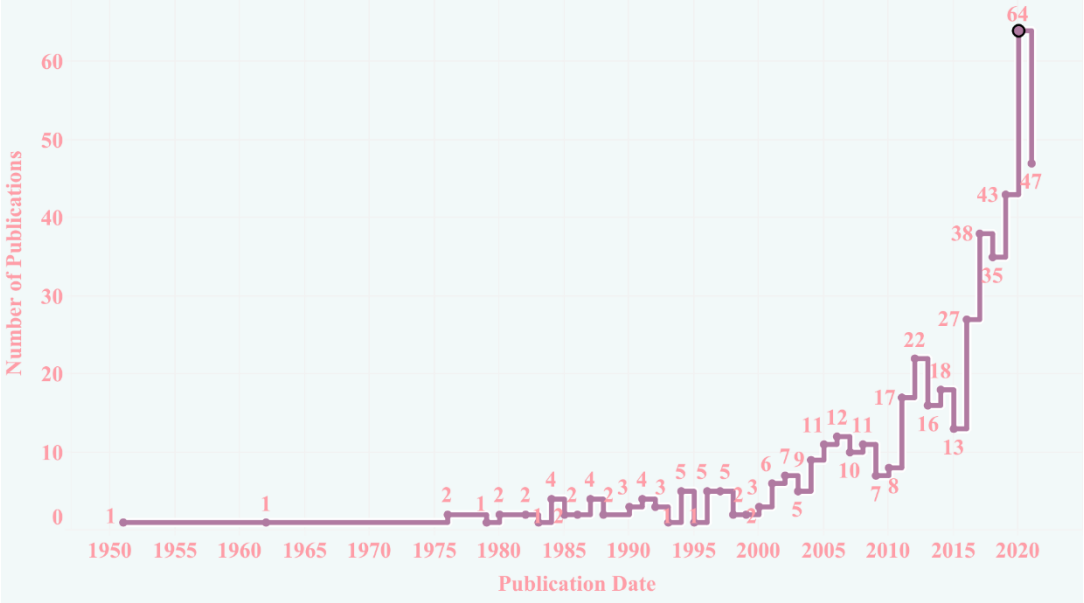

Figure 2. *Number of publications about literature elements in mathematics education between 1951 and 2021 (September)*

Accordingly, it is seen that the articles about literary elements in mathematics teaching were first published in 1951. It is seen that the number of studies on this subject has increased. But this increase does not show a regular trend. The highest number of publications (n=64) on the subject were made in 2020, and these publications constitute 13.22% of all publications on the subject.

The list of the top 10 authors who have the most publications on the use of literary elements in mathematics teaching is presented in Figure 3.

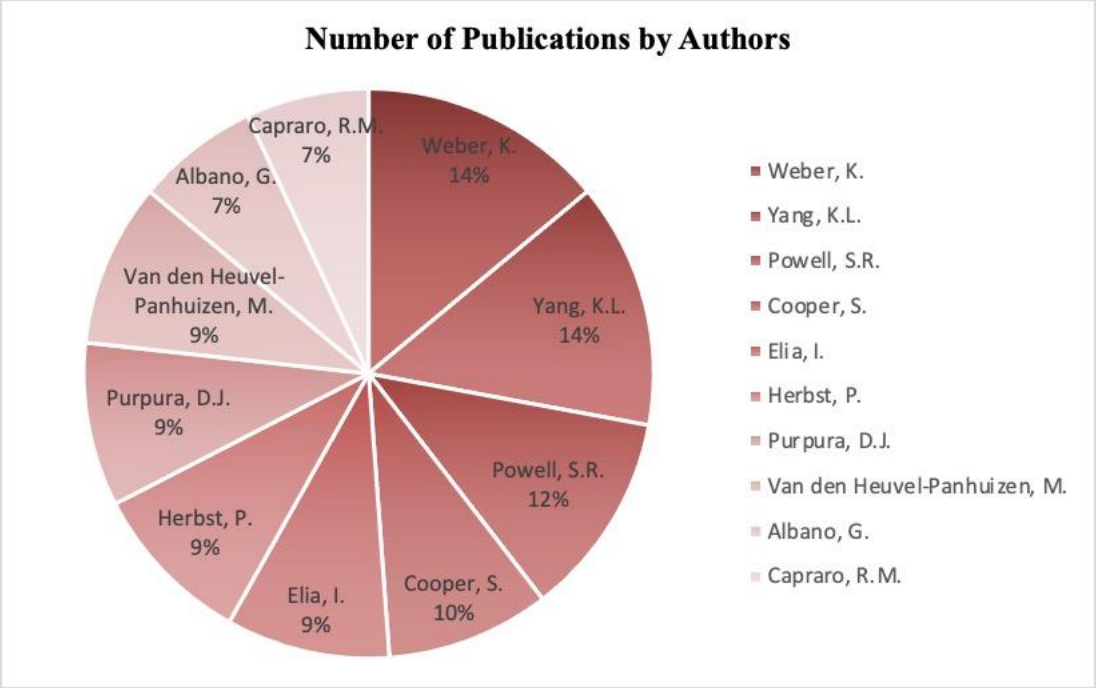

Figure 3. *Top authors of literature elements in mathematics education*

The three most prolific authors are Weber, K. (14%, n=6), Yang, K. L. (14%, n=6) and Powell, S. R. (12%, n=5), respectively. There are a total of 229 journals that include studies on using literary elements in mathematics education. Among these journals, the journals that include the most research on the subject are given in Table 1.

Table 1. *Top ten journals for using literary elements in mathematics education*

Journal	Number Of Publications	Citescore (Impact Factor)
Primus	17	0,7
International Journal of Mathematical Education in Science and Technology	14	1,9
Reading Teacher	14	1,6
Early Childhood Research Quarterly	12	4,4
Educational Studies in Mathematics	12	3,4
Journal Of Educational Psychology	11	9,5
Early Education and Development	10	3
International Journal of Science and Mathematics Education	10	4
ZDM-International Journal on Mathematics Education	10	3,6
Journal Of Adolescent and Adult Literacy	9	1,8

Accordingly, it was determined that the most publications on the subject were published in Primus (n=17) journal. This journal is followed by the "International Journal of Mathematical Education in Science and Technology", and "Reading Teacher" with 14 articles each. However, these journals are not the journals with the highest impact factor among the top 10 journals. Co-citation analysis (with at least 20 citations) of journals that include studies on literary elements in mathematics education was also conducted in the study (Figure 4).

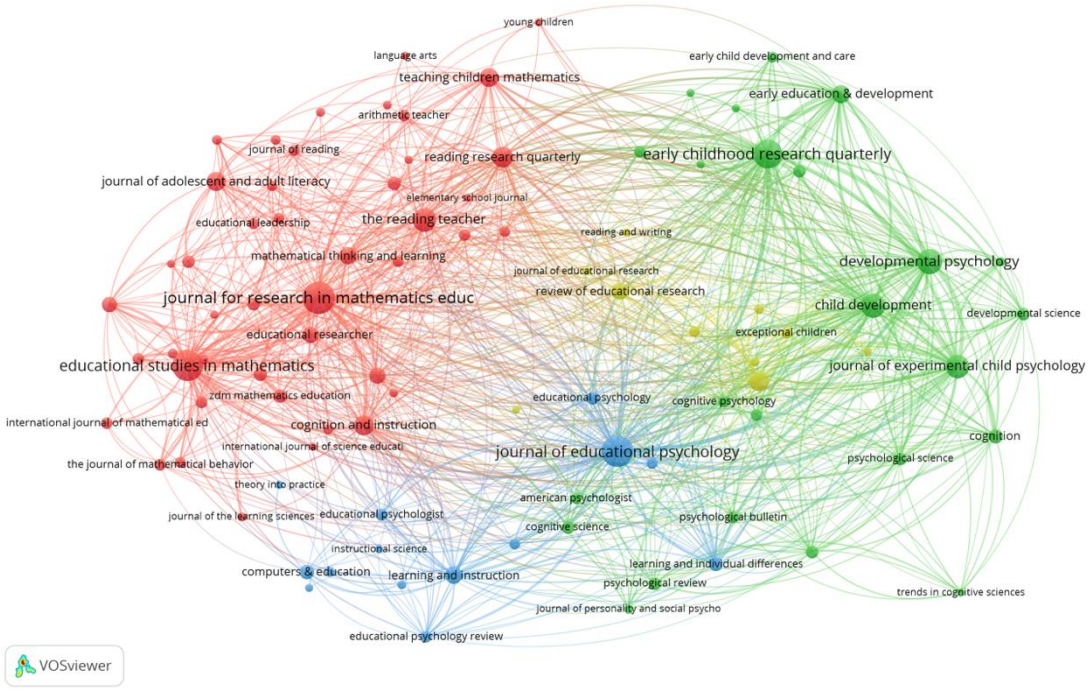

Figure 4. *Co-citation analysis on journals*

Accordingly, it was seen that the journals on this subject were collected in 4 different clusters. It was determined that the main clusters, the red cluster, mostly focused on mathematics education and reading, while the green cluster focused more on developmental psychology and special education. The distribution of studies on the using literary elements in mathematics education by institutions and countries is presented in Table 2.

Table 2. *Top affiliates and countries*

Rank	Affiliates	Record Articles	Rank	Countries/ Regions	Record Articles
1	Vanderbilt University	8	1	USA	267
1	Purdue University	8	2	UK	28
1	The University of Texas at Austin	8	3	Turkey	22
1	Texas A&M University	8	4	Canada	19
1	Michigan State University	8	5	Australia	18
1	University of Wisconsin-Madison	8	6	Indonesia	16
2	National Taiwan Normal University	7	7	Netherlands	11
2	University of Michigan Ann Arbor	7	8	Germany	9
2	Rutgers University News Brunswick	7	8	Taiwan	9
3	Florida State University	6	9	Israel Sweden	8

From the table it is seen that six universities share the first pace with eight articles each. The second place is also sharing with three universities with seven articles each. The institutions that provided the funds for the research on the using of literary elements in mathematics education were also examined in the Figure 5.

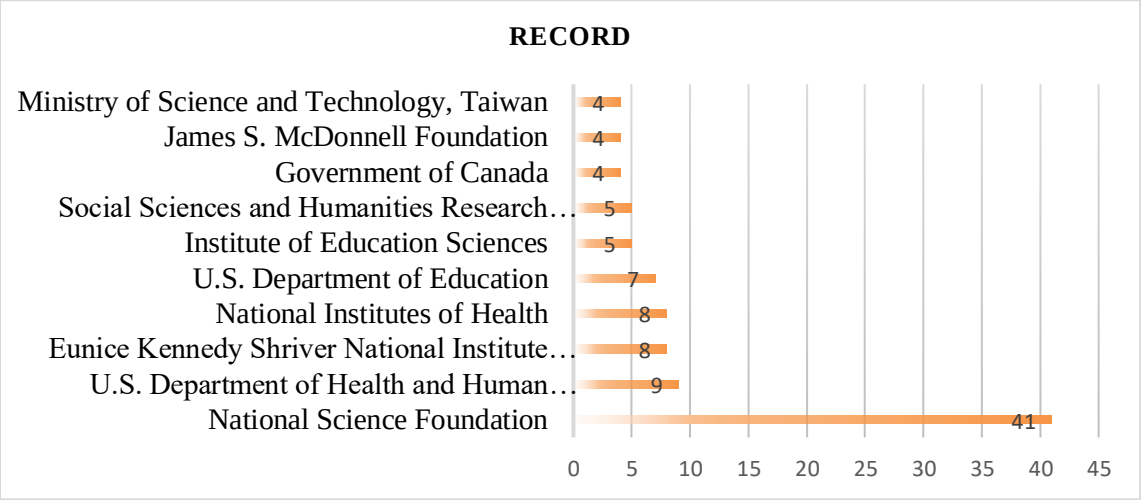

Figure 5. *Funding Agencies*

It has been determined that a total of 117 funds have been supported for research carried out in this context. Among these funding agencies, those who shared the top three places that offered the most funding was National Science Foundation (n=41), U.S. Department of Health and Human Services (n=9), Eunice Kennedy Shriver National Institute of Child Health and Human Development (n=8), National Institutes of Health (n=8) respectively. The list of the most cited publications among the studies on this subject is presented in Table 3.

Table 3. *Top articles that received the most citations*

Article	Author(s)	Published	Journal	Times Cited
1.Teaching disciplinary literacy to adolescents: Rethinking content-area literacy	Shanahan, T., & Shanahan, C.	2008	Harvard Educational Review	632
2.Number sense growth in kindergarten: A longitudinal investigation of children at risk for mathematics difficulties	Jordan, N.C., Kaplan, D., Nabors, Oláh L., & Locuniak, M.N.	2006	Child Development	363
3.A case study of computer gaming for math: Engaged learning from gameplay?	Ke, F.	2008	Computers and Education	271
4.The real story behind story problems: effects of representations on quantitative reasoning	Koedinger, K.R., & Nathan, M.J.	2004	Journal of the Learning Sciences	243
5.Formal and informal home learning activities in relation to children's early numeracy and literacy skills: The development of a home numeracy model	Skwarchuk, S.L., Sowinski, C., & LeFevre J.A.	2014	Journal of Experimental Child Psychology	219
6.Cognitive arithmetic and problem solving: a comparison of children with specific and general mathematics difficulties	Jordan, N.C., & Montani, T.O.	1997	Journal of Learning Disabilities	209
7.What is disciplinary literacy and why does it matter?	Shanahan, T., & Shanahan, C.	2012	Topics in Language Disorders	207
8.An analysis of arithmetic problem posing by middle school students	Silver, E.A., & Cai, J.	1996	Journal for Research in	197

			Mathematics Education	
9.Science as the center of a coherent, integrated early childhood curriculum	French, L.	2004	Early Childhood Research Quarterly	193
10.The development of spatial skills through interventions involving block building activities	Casey, B.M., Andrews, N., Schindler, H., Kersh, J.E., Samper, A., & Copley, J.	2008	Cognition and Instruction	169

The most cited article is published in the Harvard Educational Review with the title "Teaching disciplinary literacy to adolescents: Rethinking content-area literacy". This article was published by Shanahan T., & Shanahan, C. in 2008 and received 632 citations. When the most cited articles are examined, we are faced with a wide spectrum of research on the use of literary elements in mathematics teaching, such as problem solving, disciplinary literacy, integrated education programs (STEAM etc.), and early childhood. To represent the cooperation network between countries and authors in the context of the publications, Figure 6 is produced.

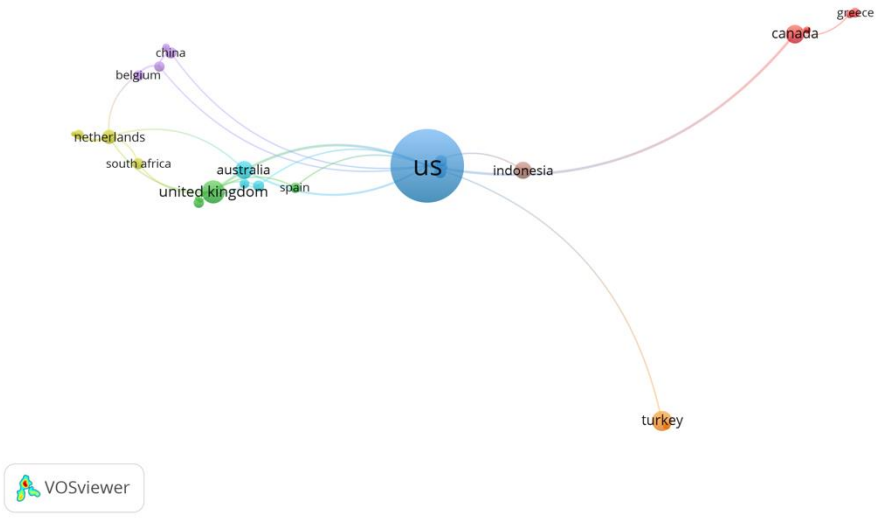

Figure 6. *Co-authorship network among countries*

The figure includes 48 countries as well as 40 links that have been formed between them. The United States (13 links), the United Kingdom (9 links), and the Netherlands (6 links) are the nations with the most connections. This demonstrates the large number of studies with an American or British focus. These nations' cooperative social networks are stronger as a result. The outcomes of the co-authorship analysis are shown in Figure 7.

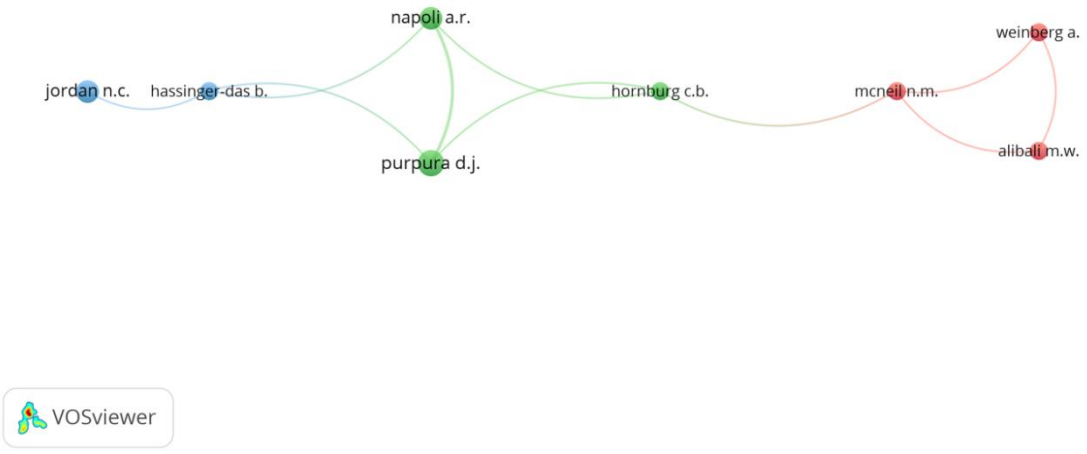

Figure 7. *Co-authorship network among authors*

A total of 10 links and 3 clusters were identified in the analysis. Authors usually appear to have 2 or 3 connections. Therefore, we can conclude that authors who carry out studies on the using literary elements in mathematics teaching mostly work alone. The authors' co-citation network analysis is presented in Figure 8.

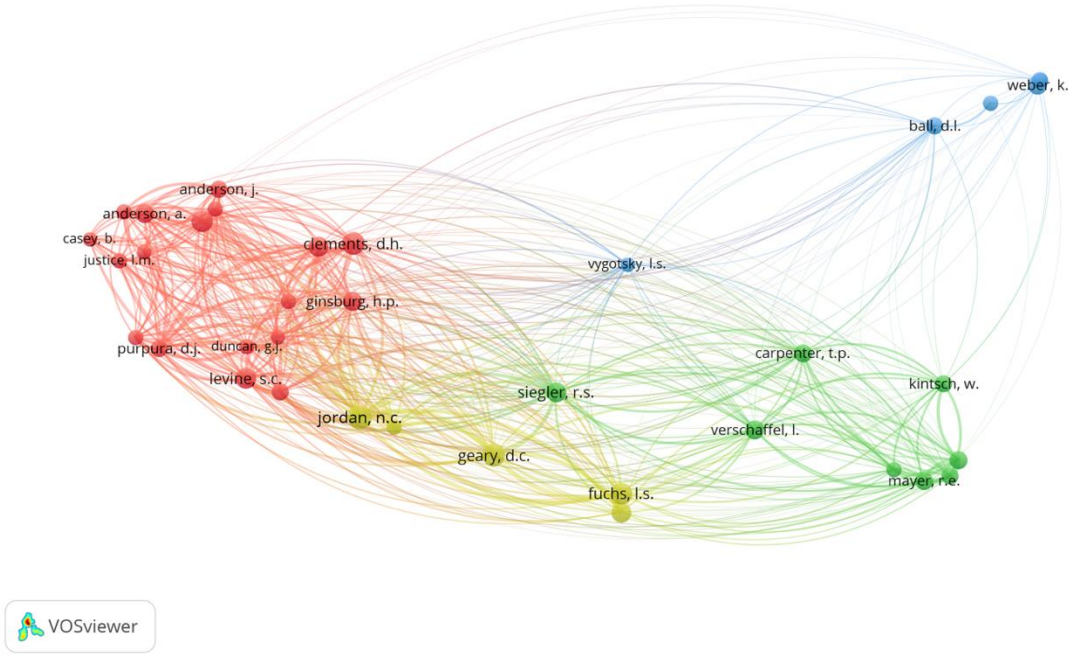

Figure 8. *Co-citation authors network*

When the cut-off point for at least 40 citations was determined among the authors working on this subject, the number of authors decreased to 37. When the co-citation network of 37 authors was examined, 4 clusters emerged. The first cluster, the red one, includes names such as Van den Heuvel Panhuizen, M., Elia, I., Ginsburg, H.P. and Casey, B. The studies in this cluster are about the use of children's literary products in mathematics teaching, children's picture books and early childhood mathematics education. Therefore, it is possible to infer that the works of the authors in this cluster are mostly cited from the focus of children's picture books. It is seen that names such as Alibali, M.W. and Carpenter, T.P. in the second cluster (green) work on story problems. The third cluster (blue) is further away from the other three clusters

and includes names such as Vygotsky, L.S. Since the use of literary elements in mathematics teaching brings in-class discussions and sharing, some studies on the subject were referred to Vygotsky's social constructivism theory (Nurnberger et al., 2020a). In the fourth and last cluster (yellow), names such as Geary, D.C., Fuchs, D., and Fuchs, L.S. stand out. Such a cluster may have emerged because these researchers work on learning disabilities focused on both language skills and mathematics in the intervention programs they developed and applied to children's books to support both areas. When the co-citation network on the use of literary elements in mathematics teaching is evaluated in general, this subject finds its answer in different subjects such as problem solving, children's books and intervention programs, and it is also cited from fields such as psychology, which is related to educational sciences, together with different fields of educational sciences.

In studies on the use of literary elements in mathematics teaching, co-word analysis was performed to reveal the frequency of keywords used by the authors and the relationship between them (Figure 9).

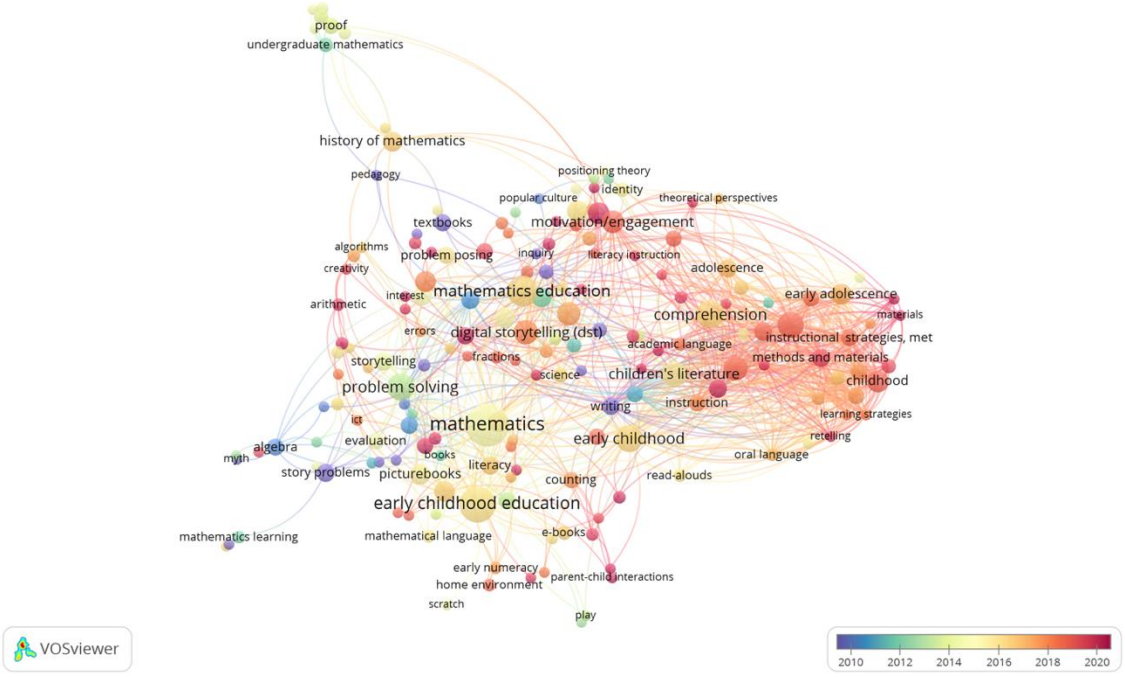

Figure 9. *The co-word analysis*

As a result of the co-word analysis, it is seen that a total of 13 but 2 main clusters emerged. These clusters are shaped around words close to the keywords "content (area) literacy and disciplinary literacy" and "elementary mathematics education (pre-school and primary school)". When the changes in the keywords used by the authors in their studies are analyzed on a yearly basis, the following picture emerges: in 2010-2012, textbooks, pedagogy, writing and constructivism; in 2012-2014 literature, reading, content area reading and problem solving; in 2014-2016, mathematics, storytelling, word problems and elementary education; in 2016-2018 early childhood, picture books, comprehension, digital storytelling, disciplinary literacy and reading strategy, and finally in 2018-2020, shared reading, parent-child interactions, preservice teachers, children's books, content literacy, and professional development keywords are used.

In addition to this, the prominent words are mathematics (n=51), early childhood education (n=32), mathematics education (n=22), (reading) comprehension (n=18), early childhood (n=17), problem solving (n=17), content (area) literacy (n=16), children's literature (n=15), instructional tools (strategy, method, technique, and material) and digital storytelling (n=13). When the connections between the keywords are examined, it is seen that the mathematics education and mathematics keywords have a connection with children's literature; there is a connection between content (area) literacy and children's literature, but there

is no connection between content (area) literacy, mathematics education and mathematics. This situation can be considered as an indication that the limitations of the keywords chosen by the authors are left aside, that the studies linking these three areas are limited. Therefore, this table, which emerged because of the common word analysis, offers some perspectives on the conceptual structure of the use of literary elements in mathematics education (Öztürk & Gökhan, 2021).

DISCUSSION, CONCLUSION, LIMITATIONS, AND RECOMMENDATIONS

A search was conducted on the Scopus database for the years 1951-21 September 2021 as part of this study, which examined bibliometric and descriptive analysis of the papers on the use of literary elements (children's picture books, stories, and reading etc.) in mathematics instruction. The inclusion criteria led to access to a total of 484 studies. First, a descriptive analysis was performed on the data. As a result, it was discovered that the first study on the issue was conducted in 1951 and that the studies revealed an erratic upward tendency. The most research on the integration of literary elements into mathematics instruction was done in 2020. Although not regularly, the number of studies generally tends to increase after 2010. In this case, the importance of various literacy such as mathematical literacy due to international exams such as "Programme for International Student Assessment (PISA)" may have played a key role. This finding of the study coincides with the results of Wu (2018). Because he also found that the change of studies on children's picture books according to years tend to increase, albeit irregularly.

Three of the researchers who have the most publications on the use of literary elements in mathematics education are Weber, K., Yang, K.L., and Powell, S.R. Weber, K. conducts studies on the reading of mathematical texts and proof as a dimension of mathematical reading. Yang K.L. has a similar ground that conducted studies on reading mathematical content and focused on reading comprehension. Powell, S. R., on the other hand, conducted studies on mathematical vocabulary, learning disabilities, and children's picture books. Powell, S. R. is followed by Cooper, S., Elia, I., Herbst, P., Purpura, D.J., and Van den Heuvel-Panhuizen, M. It is seen that the related authors also carry out studies on children's picture books, problem solving, mathematical language and stories. However, if we consider the author keywords used, it is difficult to claim that there is a high level of cooperation among researchers working on the subject. Accordingly, the studies of the authors who published the most in terms of selected keywords were carried out in a way to include different dimensions of mathematical reading and literary elements. This associates with the contribution of the context that stories and various mathematical texts provide for learning mathematics (Golden, 2012; Trakulphadetkrai et al., 2019). When the journals that include studies on this subject are examined, it is seen that the authors mostly publish in journals that focus on topics such as mathematics education, early childhood education, reading, literacy and educational psychology. This may be related to the multidimensional nature of the subject and the importance given to reading for learning.

Considering the distribution of studies on the use of literary elements in mathematics education according to institutions and countries, it is seen that there are six institutions that share the first place with eight publications each. As in the distribution of the top ten universities, the most publications on the subject originated in the USA. This may have arisen because only in English publications were included in this study. A similar view emerges when the funds received by the related publications are examined. The National Science Foundation gave the researchers the most support on this issue. The number of funds given by the institutions following the National Science Foundation are close to each other.

When the most cited publications on the subject are examined, it is seen that "Teaching disciplinary literacy to adolescents: Rethinking content-area literacy" by Shanahan T., and Shanahan, C. "What is disciplinary literacy and why does it matter?" by the same authors. Also, these publications are among the ten most cited publications. The fact that each of the articles in the top ten were published in different journals can be considered as an indicator of the multidisciplinary nature of the subject. In addition, the prominence of discipline-specific literacy such as mathematical literacy due to international exams such as PISA may be one of the reasons for this finding.

Finally, co-word analysis was performed in the study. Thus, the current research on the use of literary elements in mathematics education and the conceptual structure of the relevant subject have been revealed. Especially after 2012, the prominence of keywords such as content literacy, disciplinary literacy, storytelling, digital storytelling, pre-service teachers, picture books/children's books and professional development suggests that the professional development and storytelling processes of pre-service and in-service teachers gain importance. Research on the subject is carried out using digital media or picture books (e.g., Kıldan & İncikabı, 2015). However, the trend of research is moving towards teacher education (e.g., Farrugia & Trakulpdetkrai, 2020; Prendergast et al., 2019).

When the frequencies of the keywords are examined, it is noticed that the studies on the subject still focus on the early childhood period and children's books. This is in line with the findings of Edelman et al. (2019), Gökçe and Güner (2021), and Zhang et al. (2023). Gökçe and Güner (2021) stated that as a result of their comprehensive bibliometric review on the field of mathematics education, one of the most repeated terms is early childhood. This situation draws attention to the need for studies at advanced grade levels and different fields not only for children's literary elements and mathematics teaching but also for all mathematics education subjects in the literature. So, research examining the use of literary elements in mathematics education, especially at different educational levels in middle school school and beyond, still points to an important research gap on the subject (Zhang et al., 2023). Because, in the literature, it is noted that very few of the studies on the subject are conducted experimentally, while the studies are mostly carried out at the early childhood level (Clarissa et al., 2021; Edelman et al., 2019). The lack of an emphasis on integrating mathematics and children's literature in the curricula of many countries may be one of the reasons of this finding has emerged (Prendergast et al., 2019; Wikholm & Aerila, 2017). Another reason may be that studies based on parent-child interaction are also being conducted in this field. But, even in preschool classrooms where literary elements are often used, teachers may not consider classroom libraries to be a suitable place to do mathematics. This brings with it missed opportunities of teaching mathematics (Stites et al., 2020). The fact that the studies are mostly carried out in this age range may cause pre-service and in-service teachers to hold negative beliefs about the use of literary elements in mathematics education. Because there is still not enough evidence about how books and other literary elements other than children's books can contribute to mathematics teaching, too (Jett, 2014; Nurnberger-Haag et al., 2020a, 2020b). Also, there is some evidence about that the teachers' attitude towards using children's books for mathematics teaching is the most important factor of the mathematics and literature integration (Hsiao & Chang, 2016). Their attitudes may affect from their beliefs, awareness levels about the integration process (Can & Durmaz, 2023). Some studies show that most of the in-service teachers never use or rarely use literary elements in their classrooms (Livy et al., 2021). In line with this study, Op't Eynde et al. (2022a) call for the researchers to do much more reseach about teacher characteristics. In contrast to this call, in their mathematics education focused review Gökçe and Güner (2021) warn the researchers to focus on students rather than teachers because there are a lot of keywords such as professional development, teacher knowledge and beliefs etc in the mathematics education literature. However, in-service and pre-service teachers still need extra support for the use of literary elements in mathematics teaching (Edelman, 2017; Livy et al., 2021; Rogers et al., 2015), and when support is provided, they may develop their integration abilities (Durmaz, 2022; Wheeler & Mallam, 2020). So, this call made throughout mathematics education may not be fully responded to for a while in this field. Because professional development and teacher training are still important to develop teachers' pedagogical knowledge, experience and self-consciousnes about integration (Livy et al., 2021). But, based on the keywords that emerged in the context of this bibliometric analysis, it is thought that it is important to conduct research that reveals on which mathematics subjects, for which grade level, under what conditions, with what kind of literary elements, and on which variables the integration of literary elements into mathematics teaching is effective (McGuire et al., 2020; Op't Eynde et al., 2022b; Russo et al., 2021).

There are some limitations of this study, in which bibliometric and descriptive analyzes of articles about the use of literary elements in mathematics education are applied. First, the data of the study were obtained only from the Scopus database. The studies obtained from WOS were also accessed, but since VOSviewer, the

tool used in the analysis, could not process the data obtained from these two different databases together, the study was conducted with the Scopus database, which gave much more documents because of the literature search. In the future, more inclusive studies can be carried out by using other analysis tools with data from more than one database. Search techniques and documents are also limitations of present study. Before literature search, the keywords frequently used in studies on the subject were examined and a search code was created accordingly. Since the selected keywords were searched in the title, abstract and keywords section, a large body of research were reached in the first search. The reason for this situation is that, as seen in the findings of the research, the studies on the subject have spread to many different fields and to many different journals. The author benefited from such a search strategy because she wanted to include all studies that may be relevant to the subject. Then, to eliminate irrelevant studies, a data cleaning process was carried out and the abstracts of the studies were examined. Thus, a literature review was conducted that is both comprehensive enough to reach all the studies on the subject and limited enough to exclude irrelevant studies. In the future, research can be carried out by choosing more specific keywords. But the aim of this study is to draw a framework as inclusive as possible for researchers interested in this subject. Finally, the last access date of the data obtained through Scopus is 09.21.2021. Since new studies are included in the databases every day, it is possible to reach more comprehensive results in the future. Despite its limitations, it is thought that the framework and landscape that figured out because of this study may support researchers, practitioners and stakeholders who are interested in this subject to take the necessary precautions for the future.

REFERENCES

Acer, D., & Gözen, G. (2020). Art detectives: young children's behaviour in finding and interpreting art elements within picture books. *Education 3-13*, *48*(6), 716-732. https://doi.org/10.1080/03004279.2019.1646297

Altındağ Kumaş, Ö. (2022). Early mathematical and receptive language skills of children from different socioeconomic levels: letter knowledge a mediator. *Education 3-13*, *50*(6), 843-854. https://doi.org/10.1080/03004279.2021.2010785

Andrews, R. (2005). The place of systematic reviews in education research. *British Journal of Educational Studies*, *53*(4), 399-416. https://doi.org/10.1111/j.1467-8527.2005.00303.x

Arizpe, E. (2021). The state of the art in picturebook research from 2010 to 2020. *Language Arts*, *98*(5), 260-272.

Björklund, C. & Palmér, H. (2020). Preschoolers' reasoning about numbers in picture books. *Mathematical Thinking and Learning*, *22*(3), 195-213.

Björklund, C., & Palmér, H. (2022). Teaching toddlers the meaning of numbers-connecting modes of mathematical representations in book reading. *Educational Studies in Mathematics*, *110*(3), 525-544.

Burns, M., & Silbey, R. (2000). *So You have to teach math?: Sound advice for K-6 teachers*. Math Solutions Publications.

Can, D., & Durmaz, B. (2023). An analysis of teachers' beliefs about the integration of children's literature into the mathematics education. *International Journal of Science and Mathematics Education*, *21*(2), 489-512.

Can, D., Özer, A., & Durmaz, B. (2020). Views of pre-service primary school teachers about the integration of children's literature in mathematics teaching. *International Journal of Progressive Education*, *16*(4), 99-114. https://doi.org/10.29329/ijpe.2020.268.7

Capraro, R. M. & Capraro, M. M. (2006). Are you really going to read us a story? Learning geometry through children's mathematics literature. *Reading Psychology*, *27*(1), 21-36.

Casey, B. M., Andrews, N., Schindler, H., Kersh, J. E., Samper, A., & Copley, J. (2008). The development of spatial skills through interventions involving block building activities. *Cognition and Instruction*, *26*(3), 269-309.

Casey, B., Kersh, J. E., & Young, J. M. (2004). Storytelling sagas: An effective medium for teaching early childhood mathematics. *Early Childhood Research Quarterly*, *19*, 167-172.

Chen, X., Wang, S., Tang, Y., & Hao, T. (2019). A bibliometric analysis of event detection in social media. *Online Information Review*, *43*(1), 29-52.

Clarissa, A., Missall, K., & Artman Meeker, K. (2021). Shared book reading effects on number naming in preschoolers at risk for numeracy delays. *Infants & Young Children, 34*(2), 122-140. https://doi.org/10.1097/IYC.0000000000000187

Columba, L., Kim, C., & Moe, A. (2005). The power of picture books in teaching math and science: Grades preK-8. AZ. https://dx.doi.org/10.14507/er.v0.562

Cooper, S., Nesmith, S., & Schwarz, G. (2011). Exploring graphic novels for elementary science and mathematics. *School Library Research*, 14, 1-17.

Cooper, S., Rogers, R.M., Purdum-Cassidy, B., & Nesmith, M. (2020). Selecting quality picture books for mathematics instruction: What do preservice teachers look for? *Child Lit Educ*, 51, 110-124. https://doi.org/10.1007/s10583-018-9363-9

Cotti, R. & Schiro, M. (2004). Connecting teacher beliefs to the use of children's literature in the teaching of mathematics. *Journal of Mathematics Teacher Education*, *7*(4), 329-356.

Darragh, L. (2018). Loving and loathing: Portrayals of school mathematics in young adult fiction. *Journal for Research in Mathematics Education, 49*(2), 178-209.

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, 133, 285-296. https://doi.org/10.1016/j.jbusres.2021.04.070

Drijvers, P., Grauwin, S., & Trouche, L. (2020). When bibliometrics met mathematics education research: The case of instrumental orchestration. *ZDM-Mathematics Education, 52*(7), 1455-1469. https://doi.org/10.1007/s11858-020-01169-3

Durmaz, B. (2022). An evaluation of the preservice-teacher training for children's literature and mathematics integration. *Journal of Theoretical Educational Science, 15*(3), 605-638.

Durmaz, B., & Miçooğulları, S. (2021). The effect of the integrated mathematics lessons with children's literature on the fifth-grade students' place value understanding. *Acta Didactica Napocensia, 14*(2), 244-256. https://doi.org/10.24193/adn.14.2.

Edelman, J. (2017). How preservice teachers use children's literature to teach mathematical concepts: Focus on mathematical knowledge for teaching. *International Electronic Journal of Elementary Education, 9*(4), 741-752.

Edelman J., Green K. B., & Jett C.C. (2019). Children's literature to inform mathematics teaching and learning: a systematic review of the research literature from 1991-2016. *The International Journal of Science, Mathematics and Technology Learning*. 26(1), 49-60.

Elia, I., Van den Heuvel-Panhuizen, M., & Georgiou, A. (2010). The role of pictures in picture books on children's cognitive engagement with mathematics. *European Early Childhood Education Research Journal, 18*(3), 275-297.

Ersözlü Z., & Karakuş M. (2019). Mathematics anxiety: Mapping the literature by bibliometric analysis. *EURASIA Journal of Mathematics, Science and Technology Education, 15*(2), 1-12. https://doi.org/10.29333/ejmste/102441

Farrugia M.T., & Trakulphadetkrai N.V. (2020). Maltese teachers' beliefs concerning the integration of children's literature in mathematics teaching and learning, *Cogent Education*. 7(1), 1817253 https://doi.org/10.1080/2331186X.2020.1817253

Fellus, O., Low, D. E., Guzmán, L. D., Kasman, A., & Mason, R. T. (2022). Hidden figures, hidden messages: the construction of mathematical identities with children's picturebooks. *For the Learning of Mathematics, 42*(2), 2-8.

Forbringer, L., Hettinger, A., & Reichert, E. (2016). Using the picture book extra yarn to differentiate common core math instruction. *YC Young Children, 71*(2), 22-29.

Gaylord, S. M., O'Rear, C. D., Hornburg, C. B., & McNeil, N. M. (2020). Preferences for tactile and narrative counting books across parents with different education levels. *Early Childhood Research Quarterly, 50*(3), 29-39.

Ginsburg, H. P., & Uscianowski, C. (2017). Stories, stories, more math stories. *International Symposium Elementary Maths Teaching (Proceedings Book)*, pp. 9- 19.

Godwin, A. J., Rupley, W. H., Capraro, R. M., & Capraro, M. M. (2016). Reading and mathematics bound together: Creating a home environment for preschool learning. *Journal of Education and Learning, 5*(1), 44-59.

Golden, L. (2012). Children's literature in mathematics instruction. *Library Media Connection*. 31(2), 40-41.

Goldstein A., Cole T., & Cordes, S. (2016). How parents read counting books and non-numerical books to their preverbal infants: An observational study. Frontiers Psychology, 7. https://doi.org/10.3389/fpsyg.2016.01100

Gökçe, S., & Güner, P. (2021). Forty years of mathematics education: 1980-2019. *International Journal of Education in Mathematics, Science and Technology, 9*(3), 514-539. https://doi.org/10.46328/ijemst.1361

Green, S. (2013). Improving comprehension in middle school math by incorporating children's literature in the instruction of mathematics. [Phd Thesis]. Walden University. Retrieved from ProQuest LLC. (ED554063).

Green, K. B., Gallagher, P. A., & Hart, L. (2018). Integrating mathematics and children's literature for young children with disabilities. *Journal of Early Intervention, 40*(1), 3-19.

Günbaş, N. (2015). Students' mathematics word problem-solving achievement in a computer-based story. *Journal of Computer Assisted Learning, 31*(1), 78-95.

Güner, P., & Gökçe, S. (2021). Monitoring the nomological network of number sense studies. *International Journal of Mathematical Education in Science and Technology*. 52(4), 580-608. https://doi.org/10.1080/0020739x.2021.1895343

Harding, J., Hbaci, I., Loyd, S., & Hamilton, B. (2017). Integrating multicultural children's math books into kindergarten through sixth-grade classrooms: Preservice teachers' reflections. *The Teacher Educator, 52*(4), 386-407.

Hassinger-Das, B., Jordan, N. C., & Dyson, N. (2015). Reading stories to learn math: Mathematics vocabulary instruction for children with early numeracy difficulties. *Elementary School Journal, 116*(2), 242–264.

Hendrix, N. M., Hojnoski, R. L., Missall, K. N. (2019). Shared book reading to promote math talk in parent-child dyads in low-income families. *Topics in Early Childhood Special Education, 39*(1), 45-55.

Hojnoski, R. L., Columba, H. L., & Polignano, J. (2014). Embedding mathematical dialogue in parent-child shared book reading: A preliminary investigation. *Early Education and Development, 25*(4), 469-492.

Hojnoski, R. L., Polignano, J., & Columba, H. L. (2016). Increasing teacher mathematical talk during shared book reading in the preschool classroom: A pilot study. *Early Education and Development, 27*(5), 676-691.

Hong, H. (1996). Effects of mathematics learning through children's literature on math achievement and dispositional outcomes. *Early Childhood Research Quarterly, 11*(4), 477-494.

Hsiao, C.Y., & Chang, Y. M. (2016). A study of the use of picture books by preschool educators in outlying Islands of Taiwan. International Education Studies, 9(1), 1-19.

İnal-Kızıltepe, G., Öztürk-Samur, A., & Tekin, H. (2018). Çocuk kitapları yoluyla matematik becerilerinin kazandırılmasına yönelik yapılmış araştırmaların incelenmesi. *Adnan Menderes Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*. *5*(1), 106-123. https://doi.org/10.30803/adusobed.339278

Kıldan, A. O., & İncikabı, L. (2015). Effects on the technological pedagogical content knowledge of early childhood teacher candidates using digital storytelling to teach mathematics. *Education 3-13, 43*(3), 238-248. https://doi.org/10.1080/03004279.2013.804852

Kılıç, R. (2023). Broadening the perspectives of primary school mathematics: Past, present and further. *Education and Information Technologies, 28*(3), 3329-3357. https://doi.org/10.1007/s10639-022-11302-2

Jennings, C. M., Jennings, J. E., Richey, J., & Dixon-Krauss, L. (1992). Increasing interest and achievement in mathematics through children's literature. *Early Childhood Research Quarterly, 7*(2), 263-276.

Jett, C. (2014). Using mathematics literature with prospective secondary mathematics teachers, *Journal of Mathematics Education at Teachers College, 5*(2), 49-53. https://doi.org/10.7916/jmetc.v5i2.654

Jett, C. C. (2018). The effects of children's literature on preservice early childhood education mathematics teachers' thinking. *Journal of the Scholarship of Teaching and Learning, 18*(1), 96-114.

Jiménez-Fanjul, N., Maz-Machado, A., & Bracho-López, R. (2013). Bibliometric analysis of the mathematics education journals in the SSCI. *International Journal of Research in Social Sciences, 2*(3), 26-32.

Larkin, K., & Trakulphadetkrai, N.V. (2019). Queensland pre-service teachers' beliefs on the integration of children's literature in mathematics teaching: a pilot case study. In G. Hine, S. Blackley, & A. Cooke (Eds.). Mathematics Education Research: Impacting Practice (Proceedings of the 42nd annual conference of the Mathematics Education Research Group of Australasia) pp. 420-427. Perth: MERGA.

Lemonidis, C., & Kaiafa, I. (2019). The effect of using storytelling strategy on students' performance in fractions. *Journal of Education and Learning*. 8(2), 165-175. https://doi.org/10.5539/jel.v8n2p165

Leonard, J., Moore, C. M., & Brooks, W. (2014). Multicultural children's literature as a context for teaching mathematics for cultural relevance in urban schools. *The Urban Review Journal, 46*(3), 325-348.

Le-Thi-Thu, H., Tran, T., Trinh-Thi-Phuong, T., Le-Thi-Tuyet, T., Le-Huy, H., & Vu-Thi, T. (2021). Two decades of stem education research in middle school: A bibliometrics analysis in Scopus database (2000-2020). *Education Sciences*. *11*(7), 353. https://doi.org/10.3390/educsci11070353

Livy, S., Muir, T., Trakulphadetkrai, N. V., & Larkin, K. (2021). Australian primary school teachers' perceived barriers to and enablers for the integration of children's literature in mathematics teaching and learning. *Journal of Mathematics Teacher Education*. https://doi.org/10.1007/s10857-021-09517-0

Marín-Marín, J.-A., Moreno-Guerrero, A.J., Dúo-Terrón, P., & López-Belmonte, J. (2021). STEAM in education: a bibliometric analysis of performance and co-words in Web of Science. *International Journal of STEM Education, 8*(1). https://doi.org/10.1186/s40594-021-00296-x

McAndrew, E. M., Morris, W. L., & Fennell, F. (2017). Geometry-related children's literature improves the geometry achievement and attitudes of second-grade students. *School Science and Mathematics, 117*(1-2), 34-51.

McGuire, P., Himot, B., Clayton G., Yoo, M., & Logue, M. E. (2020). Booked on math: developing math concepts in pre-k classrooms using interactive read-alouds. *Early Childhood Education Journal, 49*(2), 313-323. https://doi.org/10.1007/s10643-020-01073-1

Mink, D.V., & Fraser, B. J. (2005). Evaluation of a K-5 mathematics program which integrates children's literature: Classroom environment and attitudes. *International Journal of Science and Mathematics Education, 3*(1), 59-85. https://doi.org/10.1007/s10763-004-2975-0

Mongeon, P., & Paul-Hus, A. (2016). The journal coverage of Web of Science and Scopus: A comparative analysis. *Scientometrics.* 106, 213-228. https://doi.org/10.1007/s11192-015-1765-5

Moral-Muñoz, J.A., Herrera-Viedma, E., Santisteban-Espejo, A., & Cobo, M. J. (2020). Software tools for conducting bibliometric analysis in science: An up-to-date review. *El Prof. Inf.* 29,1-20. https://doi.org/10.3145/epi.2020.ene.03

Nesmith, S. & Cooper, S. (2010). Trade books in the mathematics classroom: The impact of many, varied perspectives on determinations of quality. *Journal of Research in Childhood Education, 24*(4), 279-297.

Nesmith, S. M., Purdum-Cassidy, B., Cooper, S., & Rogers, R. D. (2017). Love it, like it, or leave it - Elementary preservice teachers' field-based perspectives toward the integration of literature in mathematics. *Action in Teacher Education, 39*(3), 321-339.

Nurnberger-Haag, J. (2017). A cautionary tale: how children's books (mis)teach shapes. *Early Education and Development*. *28*(4), 415-440. https://doi.org/10.1080/10409289.2016.1242993

Nurnberger-Haag, J., Alexander, A.N., & Powell, S.R. (2020a). What counts in number books? A content-domain specific typology to evaluate children's books for mathematics, *Mathematical Thinking and Learning, 23*(2), 145-169. https://doi.org/10.1080/10986065.2020.1777365

Nurnberger-Haag, J., Scheuermann, A, McTeer, J.S., (2021a). A field guide to whole number representations in children's books. *International Journal of Education in Mathematics, Science and Technology (IJEMST), 9*(4), 697-726. https://doi.org/10.46328/ijemst.1681

Nurnberger-Haag, J., Singh, R., & Wernet, J.L. (2020b). An atypical approach to improve typical issues with pre-service teachers' geometric shape knowledge. *Issues in the Undergraduate Mathematics Preparation of School Teachers.* http://www.k-12prep.math.ttu.edu/journal/1.contentknowledge/numberger01/article.pdf

Nurnberger-Haag, J., Singh, R., & Wernet, J.L., & Alexander, A. N. (2021b). Books I used as a child were mathematically incorrect: Reasons to use children's shape-related books as a resource to improve mathematical knowledge for teaching. *International Electronic Journal of Mathematics Education, 16*(3), em0642.

Op't Eynde, E., Depaepe, F., Van Den Noortgate, W., Verschaffel, L., & Torbeyns, J. (2022a). Future preschool teachers' mathematical questions during shared book reading. *European Journal of Psychology of Education.* https://doi.org/ 10.1007/s10212-022-00664-3

Op't Eynde, E., Depaepe, F., Verschaffel, L., & Torbeyns, J. (2022b). Shared picture book reading in early mathematics: A systematic literature review. *Journal für Mathematik-Didaktik*. doi: 10.1007/s13138-022-00217-7

Özkaya, A. (2018). Bibliometric analysis of the studies in the field of mathematics education. *Educational Research and Reviews, 13*(22), 723-734. https://doi.org/10.5897/ERR2018.3603

Öztürk, O., & Gökhan, G. (2021). As a tool of literature review bibliometric analysis [Bir Literatür İncelemesi Aracı Olarak Bibliyometrik Analiz]. Nobel Yayıncılık.

Pham, H.H., Vuong, Q.H., Luong, D.H., Nguyen, T.T., Dinh, V.H., & Ho, M.T. (2021). A bibliometric review of research on international student mobilities in Asia with Scopus dataset between 1984 and 2019. *Scientometrics,* 126, 5201-5224. https://doi.org/10.1007/s11192-021-03965-4

Powell, S.R., & Nurnberger-Haag, J. (2015). Everybody counts, but usually just to 10! A systematic analysis of number representations in children's books. *Early Education and Development*, *26*(3), 377-398. https://doi.org/10.1080/10409289.2015.994466

Prendergast, M., Harbison, L., Miller, S., & Trakulphadetkrai, N.V. (2019). Pre-service and in-service teachers' perceptions on the integration of children's literature in mathematics teaching and learning in Ireland. *Irish Educational Studies*. *38*(2), 157-175. https://doi.org/10.1080/03323315.2018.1484302

Pring, R. (2015). *Philosophy of Educational Research*. Bloomburry Academic.

Purdum-Cassidy, B., Nesmith, S., & Meyer, R. D., & Cooper, S. (2015). What are they asking? An analysis of the questions planned by prospective teachers when integrating literature in mathematics. *Journal of Mathematics Teacher Education, 18*(1), 79-99.

Purpura, D. J., Napoli, A. R., Wehrspann, E. A., & Gold, Z. S. (2017). Causal connections between mathematical language and mathematical knowledge: A dialogic reading Intervention. *Journal of Research on Educational Effectiveness, 10*(1), 116-137.

Purpura, D. J., Schmitt, S. A., Napoli, A. R., Dobbs-Oates, J., King, Y. A., Hornburg, C. B., Westerberg, L., Borriello, G. A., Bryant, L. M., Anaya, L. Y., Kung, M., Litkowski, E., Lin, J., & Rolan, E. (2021). Engaging caregivers and children in picture books: A family-implemented mathematical language intervention. *Journal of Educational Psychology, 113*(7), 1338-1353.

Ramirez, M.C., & Rodriguez-Devesa, R.A. (2019). A scientometric look at mathematics education from Scopus database. *The Mathematics Enthusiast, 16(*1), 37-46. https://doi.org/10.54870/1551-3440.1449

Rathé, S., Torbeyns, J., Hannula-Sormunen, M.-M., & Verschaffel, L. (2016). Kindergartners' spontaneous focusing on numerosity in relation to their number-related utterances during numerical picture book reading. *Mathematical Thinking and Learning, 18*(2), 125-141.

Rogers, R. M., Cooper, S., Nesmith, S. M., & Purdum-Cassidy, B. (2015). Ways that preservice teachers integrate children's literature into mathematics lessons. *The Teacher Educator, 50*(3), 170-186.

Russo, J., Russo, T., & Roche, A. (2021). Using Rich Narratives to Engage Students in Worthwhile Mathematics: Children's Literature, Movies and Short Films. *Educational Sciences, 11*(10). https://doi.org/10.3390/educsci11100588

Segal-Drori, O., Kalmanovich, L. B. H., & Shamir, A. (2018). Electronic book for promoting emergent math: A comparison between kindergarteners at risk for learning disabilities and with typical development. *Journal of Educational Computing Research*. https://doi.org/10.1177/0735633118769459

Skoumpourdi, C. & Mpakopoulou, I. (2011). The prints: A picture book for pre-formal geometry. *Early Childhood Education Journal, 39*(3), 197-206.

Splinter, S., Op 't Eynde, E., Wauters, E., Depaepe, F., Verschaffel, L., & Torbeyns, J. (2022). Children's picture books: A systematic analysis of features in the domain of mathematics. *Early Education and Development*, 1-20. https//doi.org/10.1080/10409289.2022.2094161

Staub, F.C., & Stern, E. (2002). The nature of teachers' pedagogical content beliefs matters for students' achievement gains: Quasi-experimental evidence from elementary mathematics. *Journal of Educational Psychology*, *94*(2), 344-355. https://doi.org/10.1037/0022-0663.94.2.344

Stites, M. L., Sonnenschein, S., Dowling, R., & Gay, B. (2020). Mathematics learning opportunities in preschool: Where does the classroom library fit in? *Early Education and Development*. https://doi.org/10.1080/10409289.2020.1721403

Suseelan, M., Chew, C. M., & Chin, H. (2022). Research on Mathematics Problem Solving in Elementary Education Conducted from 1969 to 2021: A Bibliometric Review. *International Journal of Education in Mathematics, Science and Technology*, *10*(4), 1003-1029. https://doi.org/10.46328/ijemst.2198

Toh, T. L., Cheng, L. P., Ho, S. Y., Jiang, H., & Lim, K. M. (2017). Use of comics to enhance students' learning for the development of the twenty-first century competencies in the mathematics classroom. *Asia Pacific Journal of Education, 37*(4), 437-452.

Trakulphadetkrai, N.V. (2018). Story picture books as a mathematics teaching and learning tool. *Primary Mathematics, 22*(2), 3-7.

Trakulphadetkrai, N.V., Aerila, J.A., & Yrjänäinen, S. (2019). Bringing Mathematics Alive Through Stories. In Story in Children's Lives: Contributions of the Narrative Mode to Early Childhood Development, Literacy, and Learning (pp.199-225). Springer.

Trinh Thi Phuong, T., Nguyen Danh, N., Tuyet Thi Le, T., Nguyen Phuong, T., Nguyen Thi Thanh, T., & Le Minh, C. (2022). Research on the application of ICT in mathematics education: Bibliometric analysis of scientific bibliography from the Scopus database. *Cogent Education, 9*(1), 1-14.

Uscianowski, C., Almeda, M. V., & Ginsburg, H. P. (2020). Differences in the complexity of math and literacy questions parents pose during storybook reading. *Early Childhood Research Quarterly, 50*(3), 40-50.

Van den Heuvel-Panhuizen, M. & Elia, I. (2011). Kindergartners' performance in length measurement and the effect of picture book reading. *ZDM Mathematics Education*, 43, 621-635.

Van den Heuvel-Panhuizen, M. & Elia, I. (2012). Developing a framework for the evaluation of picturebooks that support kindergartners' learning of mathematics. *Research in Mathematics Education, 14*(1), 17-47.

Van den Heuvel-Panhuizen, M., Elia, I., & Robitzsch, A. (2016). Effects of reading picture books on kindergartners' mathematics performance. *Educational Psychology*, *36*(2), 323-346.

Van den heuvel-Panhuizen, M., Van den Boogaard, S., & Doig, B. (2009). Picture books stimulate the learning of mathematics. *Australasian Journal of Early Childhood*, *34*(3), 30-39.

Van den Heuvel-Panhuizen, M. & Van den Boogaard, S. (2008). Picture books as an impetus for kindergartners' mathematical thinking. *Mathematical Thinking and Learning*, *10*(4), 341-373.

Vandermaas-Peeler, M., Nelson, J., Bumpass, C., & Sassine, B. (2009). Numeracy-related exchanges in joint storybook reading and play. *International Journal of Early Years Education, 17*(1), 67-84.

Van-Eck, N.J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, *84*(2), 523-538. https://doi.org/10.1007/s11192-009-0146-3

Ward, J.M., Mazzocco, M.M., Bock, A.M., & Prokes, N.A. (2017). Are content and structural features of counting books aligned with research on numeracy development?. *Early Childhood Research Quarterly*, 39, 47-63. https://doi.org/10.1016/j.ecresq.2016.10.002

Wheeler, A., & Mallam, W. (2020). Examing type and quality of preservice teachers' lessons based on children's literature. *International Journal on Teaching and Learning Mathematics, 3*(1), 1-11.

Wijns, N., Purpura, D., & Torbeyns, J. (2022). Stimulating preschoolers' repeating patterning ability by means of dialogic picture book reading. *Journal of Educational Psychology*, 1-16. https//doi.org/10.1037/edu0000756

Wikholm, M., & Aerila, J.A. (2017). Teaching mathematics with children's literature in Finland. New Trends and Issues Proceedings on Humanities and Social Sciences. [Online]. 01, pp 564-572. Available from: www.prosoc.eu

Wu, J.F. (2018). A bibliometric analysis of picture book research between 1993 and 2015. *Reading Psychology*, 39(5), 413-441. https://doi.org/10.1080/02702711.2018.1451419

Yalçın, M., Akkaya, R. & Durmaz, B. (2022). The effect of integrated maths lessons with children's literature on problem solving attitudes and self-efficacy. *Uludağ Üniversitesi Eğitim Fakültesi Dergisi*, *35*(3), 669-698.

Yang, D. C., Sianturi, I. A. J., Chen, C. H., Su, Y.-W., & Trakulphadetkrai, N. V. (2022). Taiwanese primary school teachers' perceived enablers for and barriers to the integration of children's literature in mathematics teaching and learning. *Educational Studies in Mathematics*, *110*(1), 125-148. https://doi.org/10.1007/s10649-021-10115-3

Young-Loveridge, J. M. (2004). Effects on early numeracy of a program using number books and games. *Early Childhood Research Quarterly*, 19, 82-98.

Zhang, Q., Sun, J., & Yeung, W. (2023). Effects of using picture books in mathematics teaching and learning: A systematic literature review from 2000-2022. *Review of Education*, *11*(1). https://doi.org/10.1002/rev3.3383

Zupic, I., & Cater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods*, *18*(3), 429-47.