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Systematic Literature Study on Early Numeracy: Relations between Early Numeracy in Early childhood and Children's Mathematics

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ABSTRAK

Numerasi ialah salah satu keterampilan yang harus dimiliki oleh anak usia dini. Keterampilan numerasi penting untuk distimulasi sebagai persiapan anak menghadapi permasalahan sehari-hari terutama yang berkaitan dengan matematika. Belum adanya kerangka literasi dan numerasi menyebabkan belum adanya batasan dan uraian terkait dengan hubungan antara numerasi awal dan matematika. Tujuan penelitian ini yaitu untuk menemukan dan menguraian hubungan antara numerasi awal dan matematika pada anak usia dini. Penelitian ini menggunakan pendekatan *sistematik literatur review* dengan prosedur PRISMA *(Preffered Reporting Items for Systematic Review and Meta-Analysis)*. Objek yang digunaan dalam penelitian adalah artikel jurnal yang terindeks secara nasional dan internasional. Hasil penelitian didapat sebanyak 284 artikel, 198 yang masuk pada tahap screening, 26 artikel pada tahap kelayakan dan 22 artikel yang memenuhi kriteria inklusi. Hasil analisis dari 22 artikel yang telah melalui prosedur penelitian menunjukkan bahwa keterampilan numerasi memiliki korelasi poitif dengan matematika. Hubungan yang terjadi diantara keduanya yaitu aspek maupun indikator dalam numerasi dapat menjadi prediktor kemampuan maupun pencapaian matematika anak dikemudian hari. Melakukan asesmen terhadap keterampilan numerasi awal dapat mendeteksi anak-anak yang memiliki potensi kesulitan dalam pembelajaran matematika, sehingga memberikan intervensi kepada anak merupakan bentuk dukungan untuk mempersiapkan anak memiliki keterampilan numerasi yang matang dan memiliki pencapaian matematika yang baik.

ABSTRACT

Numeracy is one of the skills that must be possessed by early childhood. Numeracy skills are important to be stimulated as preparation for children to face everyday problems, especially those related to mathematics. The absence of a literacy and numeracy framework means that there are no boundaries or descriptions regarding the relationship between early numeracy and mathematics. The purpose of this study was to find and describe the relationship between early numeracy and mathematics in early childhood. This study used a systematic literature review approach with the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) procedure. The objects used in the study were journal articles that were indexed nationally and internationally. The results of the study were 284 articles, 198 of which entered the screening stage, 26 articles at the eligibility stage and 22 articles that met the inclusion criteria. The results of the analysis of 22 articles that had gone through the research procedure showed that numeracy skills had a positive correlation with mathematics. The relationship that occurs between the two, namely aspects and indicators in numeracy, can be a predictor of children's mathematical abilities and achievements in the future. Conducting an assessment of early numeracy skills can detect children who have potential difficulties in learning mathematics, so providing intervention to children is a form of support to prepare children to have mature numeracy skills and have good mathematical achievements.

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1. INTRODUCTION

One of the 21st century skills that every individual must have is numeracy. Numeracy has an important role, especially in helping children solve problems in everyday life (Astuti et al., 2023; Baharuddin et al., 2021; Wahyuni, 2022). *World Economic Forum* (WEF) has underlined the urgency of numeracy as a provision for children's readiness to live their daily lives (Syamsuddin et al., 2023). Numeracy is known as *mathematical literacy* or mathematical literacy (Ayuningtyas & Sukriyah, 2020). Numeracy is a child's skill in using, understanding and applying symbols or numbers as well as mathematical operations *problem solving* in everyday life (Jayanti & Cesaria, 2024; Safitra et al., 2023). Children who have numeracy skills will shape themselves as *numbered. Numbered* is someone who is able to manipulate and implement skills, knowledge, understanding and experience of mathematics in everyday life critically (Gal et al., 2020; Perry, 2002). Currently, one of the problems of early childhood numeracy in Indonesia is the absence of a stipulation related to the literacy and numeracy competency framework for early childhood education teachers. This can lead to a lack of references related to numeracy in depth.

Numeracy has three levels, namely informal numeracy, numeracy knowledge and formal numeracy (Handayani, 2023; Muhtarom et al., 2022; Ratnasari, 2020). Early childhood children enter the simplest level of numeracy, which is the level of informal numeracy. Informal numeration is a child's skill in recognizing the qualities of objects and counting (Setyani et al., 2023; Sudarti, 2022). The level of numeracy knowledge will be experienced by the child during primary school and the level of formal numeracy will be passed by the child afterwards. Numeracy is not only related to the child's ability to count, but also related to how the child uses his counting skills as a tool *problem solving*. Children's daily activities related to numeracy include measuring plant height using non-standard measuring tools, determining the amount of sugar when making tea or forecasting the weather (Warhdani et al., 2021, p. 40).

Numeracy has a crucial role in children's mathematics learning (Afandi et al., 2021). The crucial role of numeracy lies in children's abilities and skills in managing mathematical concepts as *problem solving* (Rachmawati, 2023). Mathematics is defined as a science that deals with thinking and reasoning related to numbers and operational procedures as solving problems regarding the numbers themselves (Azhima et al., 2023; Lisa, 2018; Zulminiati et al., 2023). Mathematics is abstract, so mathematics learning in early childhood is simpler by using concrete objects that are close to the child's environment (Gunawan et al., 2024; Lubis & Umar, 2022). Mathematics and numeracy are two things that go hand in hand, however, mathematics and numeracy are still different (Han et al., 2017, pp. 3–4; Puspitasari & Watini, 2022; Tenny et al., 2021). The difference between mathematics and numeracy competencies lies in the empowerment of skills and knowledge (Ratnasari, 2020). Empowerment of numeracy skills and knowledge lies in how children use mathematical concepts in solving problems, while empowerment and knowledge of children's mathematical competence lies in how children solve mathematical problems.

Numeracy will always be related to mathematical knowledge, but mathematical knowledge does not necessarily foster children's numeracy skills (Khandria Kholifatun et al., 2023; Ratnasari, 2020). Early numeracy skills can help children understand mathematical concepts (Inayah et al., 2022). Numeracy requires mathematical knowledge in its implementation (Husna et al., 2022; Wahyuni, 2022). One example of mathematical knowledge used in numeracy skills is the use of the concept of numbers and numbers. Everyday problems are related to mathematics and require numeracy skills to solve them, such as those related to measuring distance, buying and selling or determining estimates/probabilities (Ainanda et al., 2023; King & Purpura, 2021).

It is important to develop numeracy in early childhood as a form of preparation for children at the next level of education. Numeracy and mathematics are two things that are related to each other. Therefore, this research will describe the form of relationship between early numeracy and children's mathematics based on a review Systematic Literature Review (SLR). The aim of this research is to reveal and describe the relationship between early childhood numeracy and children's mathematics skills and mathematics achievement later in life.

2. METHODS

The research method used in preparing this scientific article is Systematic Literature Review (SLR), which is a qualitative research approach. The flow of research that will be carried out can be seen in Figure 1.

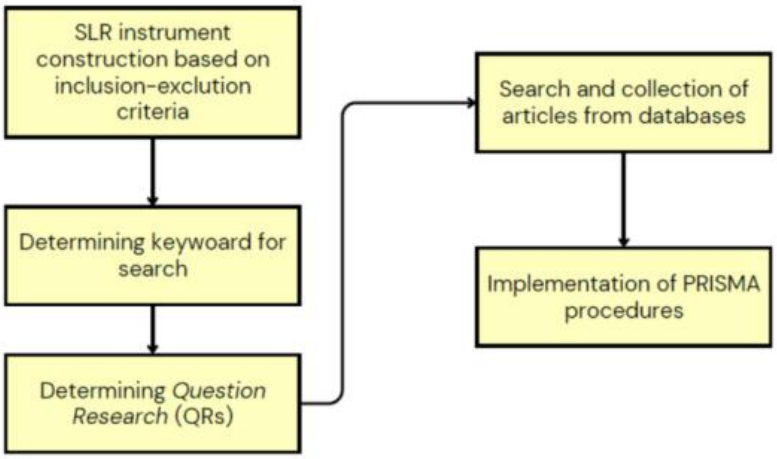

Figure 1. Research Implementation Flow

The SLR instrument used in this research is the inclusion-exclusion criteria to select scientific articles that are relevant to the research topic (Amalia et al., 2023; Bora & Sum, 2023). The inclusion-exclusion criteria for this study can be seen in Table 1 and Tabel 2.

Table 1. Inclution and Exclution Criteria

No	Aspect	Inclution	Exclution
1	Population	Focus of studies on early childhood	The focus of the studies carried ot was other than eary childhood
2	Intervention	Research that discusses children's early numeracy and mathematics	Research that does not discuss children's early numeracy and mathematics
3	Comparator	There is no comparison	There is no comparison

Table 2. Inclution and Exclution Criteria

No	Aspect	Inclution	Exclution
1	Outcome	Research that discusses the relationship between early numeracy and children's mathematical ability/skill and achievement	Research that doesn not discusses the relationship between early numeracy and children's mathematical ability/skill and achievement
2	Study Design	Research with quantitative, mix method, qualitative, R&D approaches	There are no exceptions
3	Dokumen	Research articles/scientific articles	Not a research articeles, non-

	Types	published and indexed nationally and internationally	indexted research articles, book, thesis, dissertation, proceedings
4	Publication Yeays	2015 - 2024	Before 2015
5	Language	Indonesian and English	Apart from Indonesian and english

SLR in this study uses the object of research, namely scientific journals resulting from research published with indexes both nationally and internationally. The search for scientific articles uses the Scopus, Scienc Direct, PMC PubMed, and Google Scholar databases. Keywords and the number of articles found from the search results can be seen in Table 3.

Table 3 List of Search Strings for Articles Retrieval

Database	**Keywords**	**Number of Articles**
Scopus	early AND numeracy AND mathematic	83
Science Direct	"Early numeracy", "Ealy numeracy and math skill" "Early numeracy and children's mathematic"	175
PMC PubMed	"Relation between early numeracy and children's math", "Relation between early numeracy and children's math achievement"	11
Google Scholar	"Relation between early numeracy and children's mathematical sill"	15

Question Research (QRs) in the research are used to achieve the objectives of the research implementation. The research QRs are presented in Table 4.

Table 4 *Quation Research* (QRs)

Data-base	**Keywords**
QRs 1	How is the distribution of articles based on the year they were published?
QRs 2	What is the distribution of articles in terms of the research methods used?
QRs 3	What are the numerical and mathematical measurements used in the research?
QRs 4	What are the results of research that shows the relationship between numeracy and mathematics?

The research in this article uses PRISMA guidelines *(Preffered Reporting Items for Systematic Review and Meta-Analysis)*. PRISMA is a set of evidence-based guidelines *(evidence based)* in reporting various systematic reviews and meta-analyses (Isnaintri & Novaliyosi, 2024; Sastypratiwi & Nyoto, 2020; Simamora et al., 2024). PRISMA has four stages, namely *identification stage, screening stage, eligibility stage* And *inclusion stage (Ridho & Dasari, 2023; Siswanto & Meiliasari, 2024; Syahrir et al., 2024)*. The PRISMA stages in this research were carried out with the help of software products *Qatar Computing Research Institute* (QCRI) namely Rayyan's online application (Raman et al., 2023, pp. 21–34). Implementing the PRISMA procedure in research using Rayyan's assistance resulted in PRISMA *flow diagram* which can be seen in figure 2.

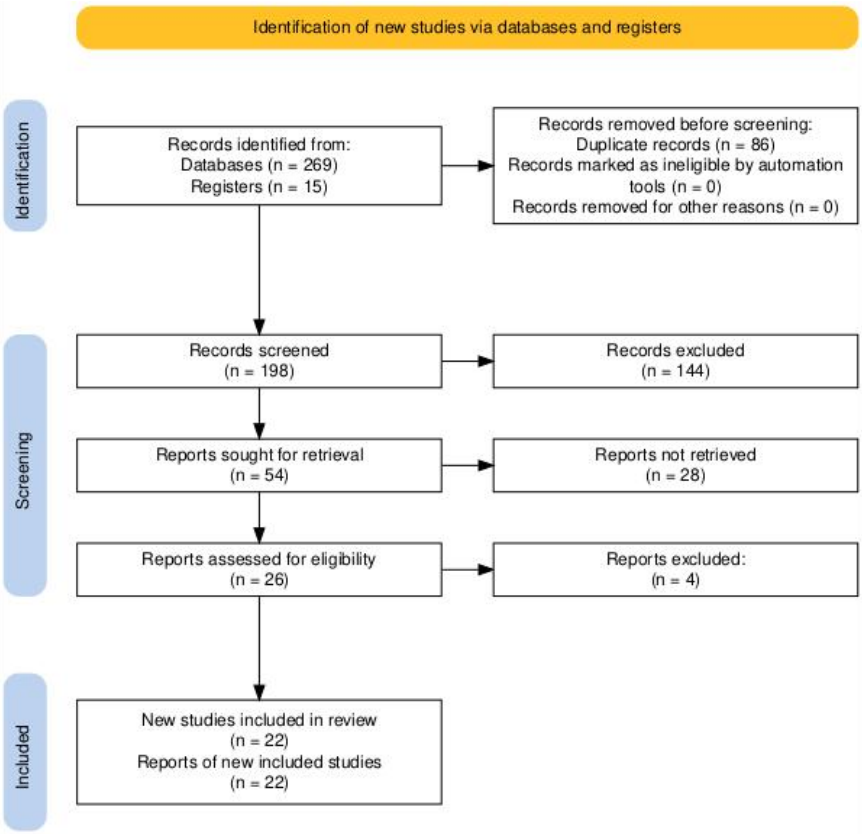

Figure 1. Identification of New Studies via Databese and Registers

3. RESULT AND DISCUSSION

3.1 RESULT

3.1.1 Studies Based on Publication Year (QRs 1)

This research using the SLR method and PRISMA procedure is based on the publication of journal articles from 2015 to 2024. The frequency of journal articles based on year of publication can be seen in figure 3.

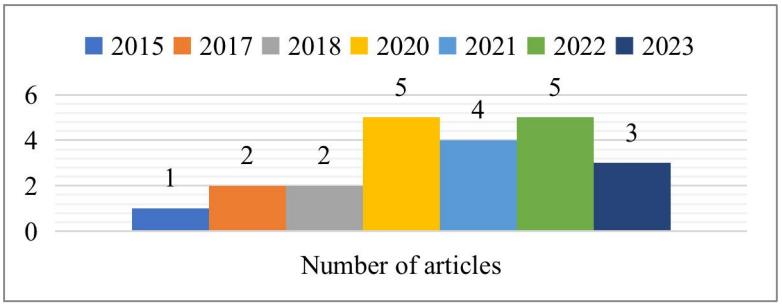

Figure 3. Frequency Based on Publication Year

Frequency based on year of journal publication illustrates varying results. Research related to the relationship between numeracy and mathematics reached the highest distribution in 2020 and 2022 with 5 journal articles published. The year of publication of the journal can be seen in Table 3. Each color in the graph illustrates the difference in the year in which the article was published. It can be seen that 2020 and 2022 have the most publications compared to other years.

3.1.2 Studies Based on Research Methods (QRs 2)

The number of journal articles studied in this research was 22 journal articles. Based on the inclusion criteria, journal articles can be taken from quantitative, qualitative, mixed method and development research approaches. The quantitative approach has the highest frequency, namely 18 articles. The qualitative approach is 2 articles, the mix method approach is 1 article and the development research approach is 1 article. A description of the method used can be seen in Figure 4.

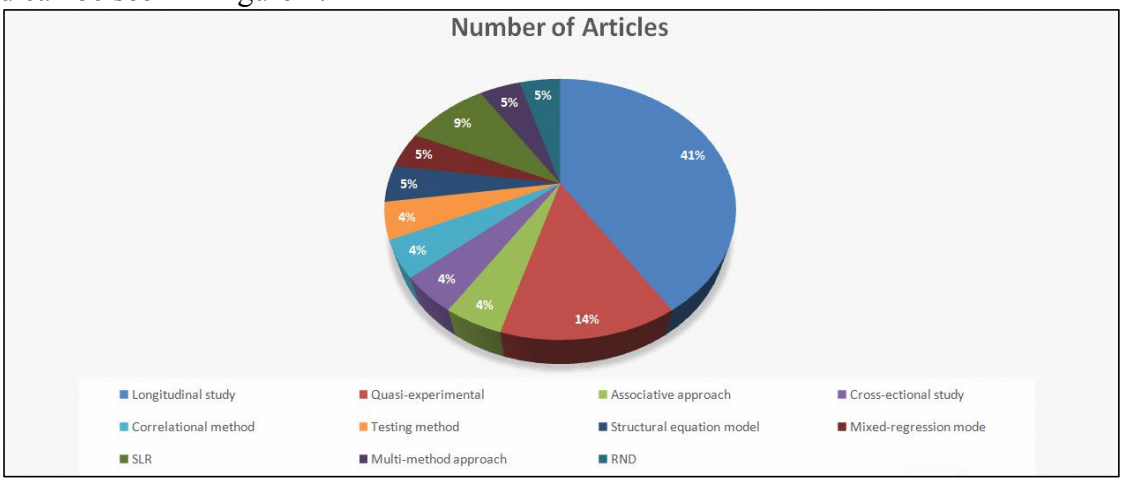

Figure 4. Number of Articles

3.1.3 Numerical and Mathematical Measurement in Research (QRs 3)

The results of the article review have found numeracy measurements and mathematics measurements in early childhood. Numeracy and mathematics measurements have been found in 20 articles using quantitative, mixed method and development research approaches. Numeracy and mathematics measurements function as measurement milestones to see the connection or relationship between numeracy and mathematics in early childhood. A description of the findings can be seen in Table 5.

Table 5 Numerical and Mathematical Measurements

Author and Year	**Numerical Measurement**	**Mathematical Measurement**
(Gashaj et al., 2023a)	Symbolic, non-symbolic and subitizing skills. Symbolic and non-symbolic skills include number line estimation. Symbol contain approximate spatial locations on a number line. Non-symbolic contains estimates/estimates of speed	Three subtests are paper based test. Subtests include comparisons, series and written calculations.
(Short & McLean, 2023)	Numerical mapping task consisting of symbolic to non-symbolic (SNS) and non-symbolic to symbolic (NSS).	The Wechsler Individual Achivement Test-3rd UK Edition (WIAT-iii UK)
(Gilligan-Lee et al., 2023)	Preschcool early numeracy skills screener-brief (PEN-B)	Block construction task
(Chan & Scalise, 2022b)	Set counting, numeral identification, number comparison, number line estimation	Forces-choce addition dan story problem addition
(Davis-Kean et al., 2022)	Substes Applied Problem dari Woodcock-Jhonson Psycho-Educational Battery-Revised, Form A	Matematics lesson transcript data wit five categories namey algebra, geometry, advanced mathematics and calculus

(Wei et al., 2022)	Numeracy activities : formal teaching (teaching counting, skip counting, comparing sizes/quantities, comparing (calculating on the computer, identifying numbers, printing numbers and simple arithmetic), number games (playing cards, playing boar games with dice/spinners, playing on the computer), number applications (counting time, talking about money and talking about hate buses/trains)	Digit Comparison dari Nosworthy, Numerical Operation from Wechsler Individual Achivement Test (WIAT-III)
(Cuder et al., 2022)	Numeracy measure covers counting, cardinality, number line knowledge	-
(Trickett et al., 2022)	Numeracy skill covers cardinality, symbolic to non-symbolic number mapping, digit naming, ordinality, verbal counting, non-symbolic arithmetic.	Spontaneous focusing on numerosity (SFON)
(Aunio et al., 2021)	Finnish Early Numeracy Test includes numeric relational skills (the concept of number comparison), numeracy skills (ordering number forward and backward, missing, word number-quantity-number symbol relationships) and arithmetic story problems	Finnish Early Numeracy Test include numeric relational skills (the concept of number comparison), numeracy skills (ordering numbers forward and backward, missing, word number-quantity-number symbol relationships) and arithmetic story problems
(Gilligan-Lee et al., 2021)	*Spatial measures* covers *disembedding (intrinsic-static skill), menal rotation (intrinsic-dynamic kills), spatial scaling (extrinsic-static skills), perspective taking (extrinsic-dynamic skills)*	*Progress in Math-ematics* (PiM) for children aged 6-8 years *The Number-Line Task* for children aged 8 years and over
(Tobia et al., 2021)	Symbolic and non-symbolic test	A standardied battery for investigating number and calculation abilities
(Girard et al., 2021)	Counting, memorizing , comparing, adding, subtracting, multiplying, talking	-
(Silver et al., 2020)	Non-symbolic number comparison using *Psychological Assessment of Numerical Ability* in measuring *approximate number system* (YEARS). Focus on numbers measured through internal activities *Spontaneous focusing on numerosity* (SFON).	*The test of early mathematics ability, 3rd edition* (TEMA-3) includes standard mathematics assessments related to number skills, comparing numbers, number literacy, mastery of number facts, counting skills and understanding concepts.
(Braeuning et al., 2020)	Basic numerical competencies include patterns, geometry, understanding numbers, arithmetic, data analysis and statistics.	ECLS-K mathematics assessment to test children's numeracy skills.
(Hellstrand et al., 2020)	Early Numeracy Test (ENT)	-
(Susperreguy et al., 2020)	Shared number-game play	Early number skill, non-symbolic mathematical outcomes (object arithmetic, number comparison-non symbolic), symbolic mathematical outcomes (number comparison-symbolic, number line estimation),

		mathematical outcomes that included both symbolic and non symbolic.
(Hornburg et al., 2018)	Early numeracy include verbal counting, one-to-one correspondence, numeral identification, cardinal (how many), cardinal (give n), connecting numerals to quantities, set comparison, numeral comparison, number order, story problem, subitizing, formal addition	Mathematical language
Mercader et al., 2018)	TEDI-MATH	The Test of Early Mathematics Ability (TEMA-3)
(Marcelino et al., 2017)	Counting, counting principle, number identification, number comparison, non-verbal calculation, story problems, number combination	Mathematic summative evaluation (MSE) meliputi sub test counting and operations, place value, applied problems, forms and spatial.
(Purpura et al., 2015)	Early Numeracy Skills Screener-Brief Version (PENS-B)	Test of Early Mahematics Ability-Third Edition

Numeracy and mathematics measurements used in a number of studies can be in the form of standardized tests and also non-standardized tests created by researchers. Standardized numeracy tests such as *Preschcool early numeracy skills screener-brief* (PEN-B), *Early Numeracy Test* (ENT) and TEDI-MATH. Standardized math tests include *The Wechsler Individual Achivement Test-3rd UK Edition* (WIAT-iii UK), *Numerical Operation* from *Wechsler Individual Achivement Test* (WIAT-III), *Progress in Math-ematics* (PiM) then *The Test of Early Mathematics Ability* (THEME-3). Non-standardized numeracy tests in research include instruments that contain indicators of both numeracy and mathematics. The instruments in the research were created by researchers and of course have been tested for validity and reliability, so that they can provide reliable and accountable results.

3.1.4 The relationship between children's Numeracy and Mathematics (QRs 4)

The findings from 22 articles related to the relationship between numeracy and mathematics in early childhood can be seen in Table 6.

Table 6 Relation between Numeracy and Mathematic

Author and Year	Result
(Gashaj et al., 2023a)	▪ Early numeracy (symbolic, non-symbolic, subitizing skills) and HLE are predictors of children's math achievement later in life ▪ -Early numeracy (symbolic, non-symbolic, subitizing skills) and math anxiety were predictors *written computation*/written calculation ▪ Symbolic skills and informal HLE are predictors *sequences*/order ▪ Skills are a predictor of ability *comparison*/comparison
(Short & McLean, 2023)	▪ There is a significant correlation related to problem solving as a predictor of numeracy scores ▪ Children's ability to represent symbolic and non-symbolic numbers (which are part of *numerical maping task*) is related to children's mathematics achievement ▪ The numeracy mapping task can be a predictor of children experiencing the risk of low mathematics achievement
(Gilligan-Lee et al., 2023)	▪ Block construction and numeration have a positive correlation ▪ Children's skills in constructing blocks have a positive correlation with children's mathematical performance in the future.

	▪ Block construction training can improve the early mathematics skills of children with low socioeconomic status (SES). ▪ Block-building skills help reduce gaps in children's math achievement based on SES
(Chan & Scalise, 2022b)	▪ Four numeracy skills *(set counting, numeral identification, number comparison, nimber line estimation)*or numeracy skills mediate the relationship between*executive function* (EF) and mathematics achievement
(Davis-Kean et al., 2022)	▪ Assignment of numeracy (mastery of counting and concrete representational arithmetic) to children at age 56 months is a predictor of mathematics achievement at age 15 years ▪ The initial numerical skills of children aged 54 months are a predictor of numerical mastery at the age of 15 years ▪ A 54 month old child's mastery of arithmetic will make the child finish middle school calculus 3 times faster ▪ Children with dominance *counting and concrete representational arithmaetic mastery* (CR) complete calculus 7 times faster than children with *no applied probem mastery* (NAP) ▪ Group children *counting concrete represantional and abstract arithmetic mastery* (CRA) completed calculus 8 times more than children with NAP ▪ Numerical skills in early childhood are a predictor of children entering college later in life.
(Wei et al., 2022)	▪ Basic teaching activities are positively correlated as predictors of number processing ▪ Advanced teaching activities and number games are predictors of arithmetic skills ▪ Basic teaching is a predictor of children's math skills (4-6 years because they already have basic knowledge of numbers) ▪ Number games are a predictor of counting skills ▪ The practice of counting is a predictor of children's early math skills later in life.
(Cuder et al., 2022)	▪ The videos provided have a positive impact on numerical training, namely counting, but not on number line knowledge ▪ There is a significant connection between the video and children's understanding of cardinality in the post-test ▪ Videos to improve children's numerical abilities, which are part of numeracy skills, can prevent children from experiencing mathematics difficulties
(Trickett et al., 2022)	▪ Numeracy activities at home are a predictor of children's math skills.
(Aunio et al., 2021)	▪ Early numeracy intervention (*numerical relationship skill, counting skill*) has a positive impact on children's achievement in mathematics ▪ An intervention program that is sequential from easy to difficult, focuses on learning materials and uses a sequence of concrete-representational-abstract is effective for children who have mathematical difficulties
(Gilligan-Lee et al., 2021)	▪ Spatial language production skills, grades and vocabulary are significant predictors of mathematics outcomes.
(Tobia et al., 2021)	▪ Symbolic and non-symbolic preschoolers are predictors of mathematics achievement in grade 1 ▪ The use of verbal and written numerical symbols (number series, simple calculations, quantities) is a factor in improving numeracy skills and is a predictor of mathematical achievement.
(Girard et al., 2021)	▪ There is a positive correlation between numeracy activities and arithmetic skills. ▪ There is a positive correlation between *home numeracy environment* (HNE) and children's math skills.
(Silver et al.,	▪ Parents who contribute to activities *Home Numeracy* more tend have children with

2020)	superior mathematical abilities. Thus, parents' activities at home are a predictor of children's mathematical abilities ▪ *Spontaneous focusing on numerosity* (SFON)/children's spontaneous focus on numbers and *approximate number system* (ANS) is a predictor of children's mathematical abilities
(Braeuning et al., 2020)	▪ Initial numeracy is formed by several basic numerical competencies, namely patterns and geometry, understanding numbers, arithmetic, data analysis and statistics ▪ Early numeracy and basic numerical competencies are an important foundation for children's numerical-mathematical development in the future.
(Hellstrand et al., 2020)	▪ The initial numeracy test (EN) has been proven to be valid and reliable as an assessment to identify children who have the opportunity to have difficulty learning mathematics
(Susperreguy et al., 2020)	▪ There is a positive correlation between number games and non-symbolic mathematical results ▪ Positive correlation related to operational activities at home with children's symbolic mathematics results.
(Mutaf-Yıldız et al., 2020)	▪ Parental contributions at home through numeracy activities have an impact on higher mathematics scores. ▪ Formal numeracy activities (helping children with tasks) are a stable predictor of children's mathematical achievements (addition and subtraction, number identification, arithmetic) later in life. ▪ Informal home numeration (activities of playing numbers together, parents' knowledge of number games) positively correlates with pictorial calculations, symbolic number line estimation performance, symbolic comparison skills, arithmetic ▪ Quantitatively, there are 30 articles that show the correlation between children's numeracy activities at home affecting children's math skills. ▪ Qualitative investigations provide 5 findings that numeracy activities at home have no correlation with mathematics skills.
(Hornburg et al., 2018)	▪ Mathematical language has a significant correlation with numeracy skills (one-to-one correspondence, verbal calculation and number identification) in children's numeracy. Language does not correlate significantly with formal subitizing/summation ▪ The child's age has a significant correlation with counting skills (one-to-one correspondence, connecting numbers with quantity, humpinan comparison, number comparison, subitizing) ▪ The child's gender is a significant factor in the number sequence model (girls prefer this) ▪ Parental education is significantly correlated with one-to-one correspondence, word problems, and cardinality
Mercader et al., 2018)	▪ *Motivation (Mot), affect early numeracy skill (ENS), executive function (EF) and mathematical performance (MP)* ▪ *ENS affects MP* ▪ *EF, Mot, ENS are predictors of children's mathematical performance in the future*
(Marcelino et al., 2017)	▪ Early numeracy has been proven to have a correlation with children's mathematics achievement ▪ *Number sense brief screener* (NSB) is a predictor of children's mathematics achievement, but the NSB subarea, namely counting and counting principles, does not have statistical significance as a predictor of mathematics achievement. ▪ Numeracy indicators (number identification, story questions, number combinations) are predictors of children's mathematical performance in the future
(Raghubar &	▪ The results of learning to identify numbers, compare and manipulate quantities become an important part of early numeracy

Barnes, 2017)	▪ Early numeracy is a strong predictor of children's learning and math performance in school ▪ *Hands early number knowledge* and neurocognitive abilities can assess the risk of mathematics learning difficulties
(Purpura et al., 2015)	▪ PENS-B items become the main dominant predictor of NCTM ▪ The PENS-B items serve as an initial screener in preschool to demonstrate a robust risk classification for mathematics difficulties

3.2 DISCUSSION

Numeracy skills can include symbolic and non-symbolic understanding, calculation skills and mathematical correlations (Diana et al., 2023; Raghubar & Barnes, 2017; Shvartsman & Shaul, 2023). Children's understanding of symbols includes understanding the meaning of symbols as well as children's ability to count sequentially and children's non-symbolic understanding includes the ability to manage or operate numbers with number objects (Ain et al., 2023). Children's understanding of symbolic and non-symbolic is one of their numerical abilities. Numerical ability is an individual's ability to implement basic mathematics, namely calculating correctly (Ashkenazi et al., 2024). Numerical abilities apart from symbolic and non-symbolic are counting skills, mathematical correlations and basic mathematical skills (Aunio & Räsänen, 2016)). Numerical ability can be applied to numeracy skills. Children who have numerical abilities and children can use them in everyday life, then this shows that the child is at the numeracy skill stage.

The content contained in numeracy skills is the ability to count, identify numbers, compare numbers, estimate number lines and investigate multiple numeracy skills (Chan & Scalise, 2022). Children's counting skills include the ability to match numbers and the number of objects correctly. Counting skills in children include six stages, namely primary understanding, acoustic counting, asynchronous, synchronous, resultative and short counting (Aunio & Niemivirta, 2010). The first stage, primary understanding, shows that the child will understand that the number of objects will affect the number. The second stage, acoustic counting, is the child's ability to count randomly. The third stage, asynchronic, is the stage where children count and match, but at this stage there is no match between the number of objects and the numbers mentioned. The fourth stage, synchronic, continues the previous stage and the child is able to adjust the number and number of objects. The fifth, resultative stage occurs when the child is able to count sequentially and understands that the last number is the sum of all the objects being counted. The sixth stage, short counting, means that children are able to count and recognize numbers correctly. Number identification ability is the child's ability to understand the meaning of words from a written number. Number comparison ability is the ability to map number words to numbers in magnitude, so that children will be able to understand the words "more, less, medium". The process of children understanding the meaning of quantities "less, more and others" is also included in relational skills. Skills include sorting, one-to-one correspondence comparing and classifying (Vanhala et al., 2024). Children's understanding of the relative magnitudes of numbers is one of the foundations of children's mathematics. Number line estimation ability is the child's ability to estimate numbers on a number line. Number line estimation can be a predictor of children's mathematical competence (Schneider et al., 2018). The ability to investigate multiple numeracy skills is the child's stage in maturing and mastering the ability to count, number identification, number comparison and number line estimation (Chan & Scalise, 2022).

Numeracy skills are not far from the mathematical content in them, so they cannot be separated from children's mastery of mathematical language (Gashaj et al., 2023; Trickett et al., 2022). Mathematical language is the terms or vocabulary used in mathematics (Purpura et al., 2019). Quantitative mathematical language can include the words “little”, “many”, “less”,

"more" (Purpura et al., 2019). Mathematical language related to children's spatial abilities includes the words "far", "near", "above", "below" (Illiyin et al., 2022). A child's ability to master the language of mathematics will also influence the child's mastery of numeracy skills (King & Purpura, 2021). The mathematical language mastered by children has a specific correlation with numeracy, especially children's numeracy skills (Hornburg et al., 2018).

Numeracy activities that children do can be a stimulator to develop and train children's numeracy skills. Children's numeracy activities at school can be done by teachers by making fun learning innovations (Putri et al., 2021). Fun numeracy activities can be done by telling stories using media big book (Simatupang et al., 2023). Learning using the STEAM method (science, technology, engineering, art and mathematic) which uses materials loose part can be an activity that stimulates children's numeracy skills (Raniah & Rakhmawati, 2023). Numeracy activities involving parents in the family environment can be a factor that influences children's numeracy skills (Vasoya & Vansdadiya, 2023). Numeracy activities carried out at home by parents are also called Home Numeracy Environment (HNE) (Elliott et al., 2023). HNE which includes activities in counting, remembering, comparing, adding provides a positive correlation to the mathematical skills that children will master (Girard et al., 2021). Children's mathematical abilities will tend to excel if parents can contribute to numeracy activities at home (Silver et al., 2020).

One of the implications of this research for education is as a source of knowledge related to the relationship between children's early numeracy and mathematics. Schools can use this article as a reference to explore more deeply that children's early numeracy has a significant influence on children's mathematics and later achievement. Collaboration between the school and the family greatly influences children's achievement in the areas of numeracy, mathematics and children's achievement. Future research is expected to further explore how correlations between numeracy and mathematics or children's achievements can occur, so that new knowledge will be obtained that can be used by teachers and parents to improve or create new strategies in learning.

4. CONCLUSION

Early numeracy skills play an important role in helping children face difficulties and challenges in everyday life, especially those related to mathematical concepts. Proper stimulation and assessment is needed to provide direction and review regarding children's early numeracy and mathematics. Early numeracy skills can detect children who may have difficulties in mathematics later in life, so carrying out an assessment or assessment of children's early numeracy skills is important. Numeracy activities at home and numeracy activities at school are crucial things that must be considered because both will have an impact on children's mathematical and academic performance and achievements at further levels of education.

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