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Dear Laela Sagita, Ratu Ilma Indra Putri, Zulkardi, Rully Charitas Indra Prahmana,

We have decided on your submission to the Journal on Mathematics Education entitled Promising research studies between mathematics literacy and financial literacy through project-based learning. After reviewing your revised paper, our editorial committee considered accepting your article.

Herewith, we attach the invoice for your paper. Furthermore, we will proceed with your manuscript to the next step of the production process. Should you have any questions, please do not hesitate to contact us.

Thank you very much for your cooperation. We do really appreciate your work.

Kind Regards,

Prof. Dr. Zulkardi, M.Ikomp., M.Sc.
Editor in Chief
Journal on Mathematics Education

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Promising research studies between mathematics literacy and financial literacy through project-based learning

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Abstract

Financial literacy is a knowledge and attitude about finance and is a 21st-century skill. As knowledge, a cognitive factor of a person will impact their financial literacy skill. Through a bibliometric analysis study of 274 documents published during 1994 to 2021 from the Scopus database, we found that mathematics literacy is the cognitive factor of one's financial literacy skill. The OECD and several studies offer intertwined concepts, financial literacy, and mathematics, to be presented in the mathematics curriculum in primary and secondary schools. We present a framework for implementing financial literacy in mathematics through three dimensions, content, context, and process. The dimension content consists of mathematics' and financial content. Furthermore, the dimension context related to education and work, home, and family, individual and societal. As a cognitive process, the dimensions of the process based on Bloom's Cognitive stages. The potential for future research is developing learning activities. Project Based Learning is the most approach to implementing financial literacy in mathematics classes.

Keywords: Financial Literacy, Junior High School, Mathematics Literacy, Project-Based Learning

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Several countries agree on the importance of Financial Education (FE) not only for adults, but also adolescents or school-age children. In line with OECD to provide financial education in the school curriculum as a separate subject or as a cross-curricular subject (OECD, 2015). Through the implementation of financial education in schools, students are familiar with financial terms (Sole 2014). One of the ways to implement financial literacy in the school curriculum is integrate in related subjects such as mathematics, social science, civic education, and economics (OECD, 2019). Strengthened by the findings of three most effective forms to delivering financial education, such as a cross curricular subject (Salas-Velasco et al., 2021), personal course of business and economics (Dituri et al., 2019; Salas-Velasco et al., 2021), and part of mathematics subject (Dituri et al., 2019; Salas-Velasco et al., 2021; Bottazzi & Lusardi, 2020; Indefenso & Yazon, 2020; Ozkale & Erdogan, 2020; Cole et al., 2016).

One of the factors that influence individual LF is ability in mathematical content. According results financial literacy on PISA 2015, a students could not achieve the mini-mum score in the test despite they have basic knowledge about financial concepts almost 22% (OECD, 2015). This issue was addressed

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on the OECD 2020 report that the right financial decision is not only influenced by knowledge of financial concepts, but also basic mathematics (OECD, 2020). The success of implementing FE in the mathematics curriculum depends on several aspects, including learning materials and strategies. The preparation of mathematical material can use real-world financial contexts (Salas-Velasco et al., 2021; Sawatzki & Sullivan, 2018; OECD, 2019). Furthermore, in designing learning can use project-based learning with a particular financial problem (Dituri et al., 2019; Opletalova, 2015).

Recently, Indonesia has carried out an improvement in the educational paradigm which is marked by the implementation of independent curriculum. Some of the things that we underline in the new curriculum include the application of project learning and added financial literacy through mathematics. We will formulate how to prepare teachers to implement financial literacy in mathematics ased on prior studies. Teachers can use our findings to design mathematics lessons that include financial literacy.

We present the article in a structured manner, the research background as a starting point to conduct a framework for implementing financial literacy through mathematics classes. **We provide a bibliometric study on the relationship between mathematics and financial literacy. In line with the prior study, many studies show the effect of mathematics on financial literacy.** Bibliometric as quantitative cross-disciplinary science analyses the patterns of published literature (Singh & Dhir, 2019) and maps the development of a field of science (Aidi Ahmi, 2019). **The next chapter explained the research method, consisting of bibliometric literature and the teacher-school readiness survey.**

The discussion section is divided into three parts: presentation of bibliometric analysis, theory of financial literacy and mathematical literacy, and ends with a discussion of applying financial literacy in mathematics class. Afterwards, next discussion is the survey results of a school readiness in implementing project learning and teachers' knowledge of financial terms. Finally, in the conclusion section, all findings are summarized and recommendations for future researchers are proposed.

The next section discusses the literature related to this research study, namely the literature on financial literacy and other domains and financial education in several countries. The result and discussion section describe several interesting findings from this research study in detail and comprehensively in the results and discussion section. We also present the results of our initial research related to financial literacy. Finally, in the conclusion section, all findings are summarized and recommendations for future researchers are proposed.

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METHODS

This study is a systematic review based on bibliometric profile articles from the Scopus database using the Biblioshiny for Bibliometrix R package and VOSviewer version 1.6.17. Bibliometric analysis is a statistical method to analyze patterns of published literature (Singh & Dhir, 2019) or specific trends and patterns of scientific development (Aidi Ahmi, 2019). The pattern of development can be seen from the number of citations, citations per year, citations per author, thematic map, world cloud, co-authorship, and co-citation. This study has three focus patterns, thematic map, world cloud, and co-occurrences.

The analysis in this study began with identifying and collecting data from the Scopus database on August 23, 2022. Data collection was based on Moher et al. (2009), as presented in Figure 1. The initial search used three keywords, namely (TITLE-ABS-KEY (mathematics AND literacy) AND TITLE-ABS-KEY (financial AND literacy) OR TI-TLE-ABS-KEY (numeracy)). The subject areas were limited to only social science, mathematics, art, and humanity to ensure the correspondence of the data used.



Mohon tambahkan tahapan survei yang dilakukan dalam mengumpulkan data dan menganalisisnya sehingga bisa menceritakan tambahan informasi yang mb tulis di akhir bagian diskusi. Berapa sampel nya, dimana dilakukan, dan proses analisis data nya. 1 paragraf aja.

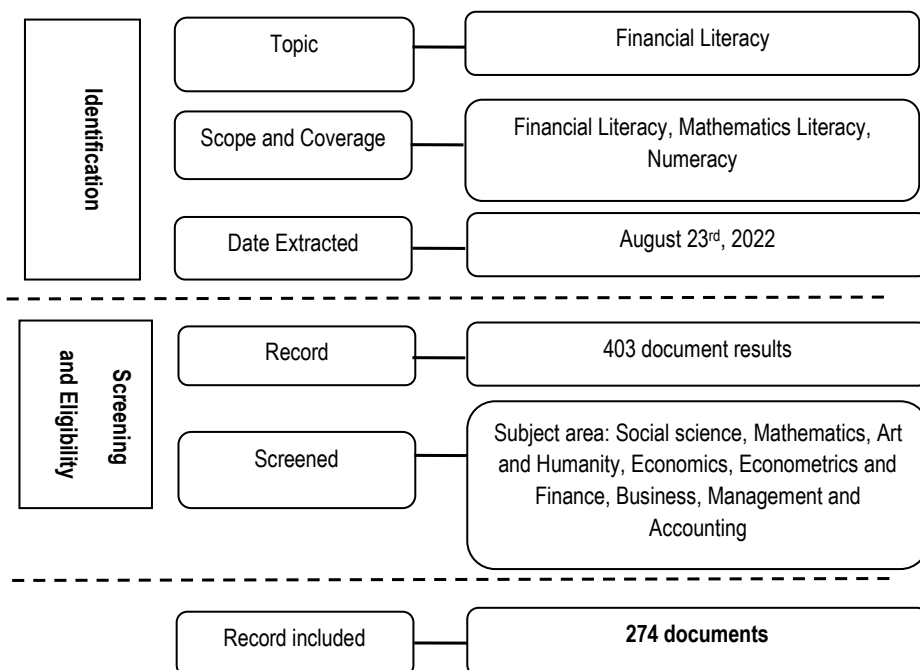


Figure 1. The flowchart in data collection



enam sekolah menengah negeri di distrik Ndola Zambia. Desain penelitian metode campuran sekuensial sekuensial (Cresswell, 2014) digunakan di mana tanggapan tertulis guru dikumpulkan menggunakan kuesioner tertutup. Enam puluh dua guru matematika menyelesaikan kuesioner. Setelah pemberian angket, observasi pembelajaran matematika dilakukan pada satu kelas 11 yang dipilih secara acak dari masing-masing sekolah yang berpartisipasi. Pendekatan penelitian metode campuran dianggap menguntungkan karena memberikan kesempatan untuk mengumpulkan data kuantitatif dan kualitatif untuk mendapatkan wawasan yang lebih dalam tentang situasi yang ada. Cresswell (2014) menyoroti bahwa pendekatan penelitian metode campuran memiliki kemampuan untuk memberikan pemahaman yang mendalam dan lengkap tentang situasi yang ada dibandingkan dengan melakukan pendekatan penelitian kualitatif atau kuantitatif.

Survey dilakukan kepada guru yang berasal dari 15 sekolah di Daerah Istimewa Yogyakarta yang dipilih secara random. Survey pengetahuan literasi keuangan guru terdiri dari empat aspek yang mengadopsi financial literacy quitionaire 2018 sebagai berikut :

Aspect	Indikator
Financial context in mathematics learning	
Knowledge and attitudes about financial in learning mathematics	
Teacher's understanding in financial terms	
Avaliability of financial literature in the school	

RESULTS AND DISCUSSION

Bibliometric Analysis

Table 1 presents general information from the data sources used in the bibliometric analysis in this article. Which is 274 documents found from 644 authors. The largest pro-portion is articles, around 75%, while the rest is a combination of books, book chapters, conference papers, conference reviews, notes, and reviews. These documents were published in 187 sources with an average citation score per document of 16.14 and average citations per year per document of 1.87, indicating the degree of collaboration between re-searchers.

Table 1. Main Information about Data

Description	Result
MAIN INFORMATION ABOUT DATA	
Timespan	1994:2022
Sources (journals, books, etc.)	187
Documents	274
Average years from publication	6.55
Average citations per document	16.14
Average citations per year per doc	1.87
References	12146



Description	Result
DOCUMENT TYPE	
Article	206
Book	8
Book chapter	39
Conference paper	11
Conference review	2
Note	1
Review	7
AUTHOR	
Authors	644
Author Appearances	717
Authors of single-authored documents	67
Authors of multi-authored documents	577
Authors	644
Author Appearances	717
Authors of single-authored documents	67
Authors of multi-authored documents	577

We present two types of data visualization based on the most frequent keywords: Word Cloud and Co-Occurrence Keywords. The order of keywords in the data search is mathematical literacy, followed by financial literacy, and numeracy. The term "numeracy" in Figure 2 has the largest size or has 54 occurrences of the 274 article documents, followed by the term "financial literacy" that occurs 33 times, the terms "literacy" and "mathematical" which occur 21 times, then "mathematics literacy" that occurs 10 times. Based on the VOS Viewer output in Figure 2, the keywords that appear the most are used in the data search. Even though this is natural, we use this output to determine the size or weight and the relationship between keywords. We do not ignore other keywords because we use them in constructing the conceptual discussion, for example: financial education, curriculum, PISA, quantitative literacy, realistic mathematics, arithmetic, and curriculum development.

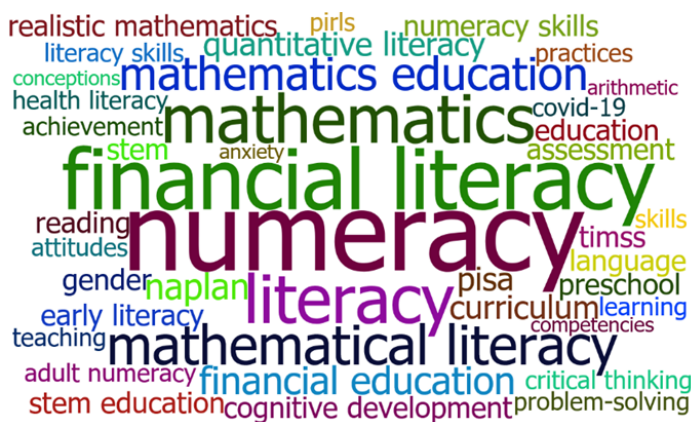


Figure 2. Bibliometric Word Cloud and Co-Occurrence Keywords



Figure 3 is the result of keyword mapping using VosViewer. The visualization map shows that the topic of "numeracy" affects other topics with a large circle size on the topics of "mathematics" and "financial literacy". Networks between keywords are presented with different colors, circle sizes, and thicknesses of plot lines representing a measure of the strong collaboration between each author and productivity or citations (Van Eck & Waltman, 2020).

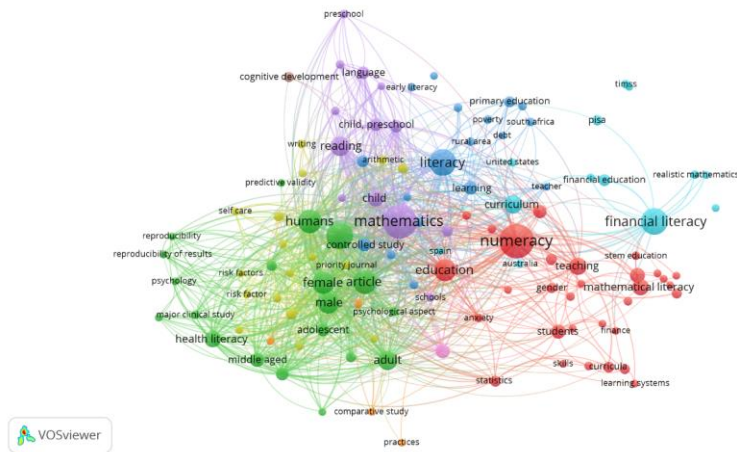


Figure 3. Co-occurrence of Keyword Mapped using VosViewer

When we highlight the keyword financial literacy, all the keywords show that there are networks between keywords. Word analysis aims to determine the conceptual structure using word-occurrence networks (Cole et al., 2011). Figure 4 shows that financial literacy has a direct co-occurrence with several keywords based on circle size: numeracy, mathematics, education, mathematics literacy, article, curriculum, student, financial education, realistic mathematics, PISA, e-learning, finance, and problem solving. There are four strong networks on keywords presented in Figure 4 based on the size of the circle and the thickness of the links (lines): mathematics, numeracy, financial literacy, and mathematics literacy. It concluded positive correlation between mathematics, numeracy, financial literacy, and mathematics literacy. It is not surprising because some studies have discovered a strong positive correlation between financial literacy and mathematics literacy (Sole, 2014; OECD, 2019; Ozkale & Erdogan, 2020) or numeracy (Huston, 2010; Lusardi, 2012; OECD, 2019; Bottazzi & Lusardi, 2020; Indefenso & Yazon, 2020).



Figure 5. Thematic mapping using Bibliometrix-R package

Quadrant 1 has four themes and one of them is between Quadrant 2. This theme has high density and centrality and is the motor that drives basic themes (Bashir 2022). Based on the location and size of the circles, one theme that is the major theme in this cluster, namely the theme group with pink circles (mathematical literacy, mathematical education, and quantitative literacy). Quadrant 2 is highly developed but isolated theme: fuzzy-trace theory and financial inclusion. The themes in quadrant 2 and quadrant 3 do not affect other themes outside the quadrant (Cobo et al., 2011). So, this is not a focus of attention for us. The theme of fuzzy trace theory is a theme in the health sector, for example the numeracy health articles by Lipkus and Peters (2009), Reyna and Brainerd (2008), and Reyna and Brainerd (2007). Meanwhile, Quadrant 4 of Figure 5 represents a basic theme and enlists six circles in different sizes. The themes in quadrant 4 have significant research contributions. Based on circles' location and circle' size there are two major research themes in this quadrant, namely the red circle (numeracy, literacy, mathematics) and the purple circle (financial literacy, financial education, curriculum). Several researchers who revealed this relationship discuss the effect of mathematics and financial literacy on students (Yildirim & Vardari, 2020). Savard students discovered Grade 4 has many representations of financial concepts that emerged while learning mathematics (Savard, 2019).

Conceptual Development: What is Financial Literacy?

Financial literacy divided into two main dimensions: knowledge and attitudes in managing finances (Ouachani et al., 2020). Knowledge and understanding of financial management will lead to financial attitudes or behavior, for example, deciding to save money for the long term, planning a household budget, budgeting for insurance, choosing financial products, etc. These two dimensions are interrelated, a good knowledge of financials accompanied with the right financial attitudes (Kaiser & Menkhoff, 2018; Savard, 2022; Ozkale & Aprea, 2022).

Financial literacy is a comprehensive and broad concept. Not only the discipline of economics but involving several other disciplines. The comprehensive concept of financial literacy caused experts to define it differently (Goyal & Kumar, 2021). The following are some definitions of financial literacy. Atkinson and Messy (2012) define financial literacy as a combination of awareness, knowledge, skills, attitudes, and behaviors that are needed to make sound financial decisions and ultimately to achieve individual financial well-being. Meanwhile, Lusardi (2019) define financial literacy as the ability of individuals to use knowledge, skills, and confidence to make the right financial decisions. Huston (2010) made the concept of financial literacy as an understanding and use of personal finance-related information. People become financial literate when they have the knowledge, understanding, and skills to solve personal financial problems (Goyal & Kumar, 2021).

The concept of financial literacy is not only instilled in adults but also adolescents. OECD identified



specific applications the definition of financial literacy relevant for students aged 15 years: financial literacy is knowledge and understanding of financial concepts and risks, as well as the skills and attitudes to apply such knowledge and understanding to make effective decisions across a range of financial contexts, to improve the financial well-being of individuals and society, and to enable participation in economic life OECD (2019). Meanwhile, Jump\$tart Coalition, a US non-profit coalition of national organizations seeking to advance the financial literacy of students from pre-kindergarten through to college-aged, defines financial literacy as the ability to use knowledge and skills to manage one's financial resources effectively for a lifetime of financial security (Jump\$tart Coalition, 2007).

Conceptual Development: Financial Literacy in Mathematic Literacy

This sub-section will present a simple review related of financial literacy and mathematics literacy based on the theory proposed by the OECD. In particular, the OECD defines mathematics literacy for the domain of 15-year-olds as the capacity of individuals to reason mathematically and use mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena (OECD, 2019). PISA measures mathematical literacy based on three dimensions. Firstly, context, namely personal, occupational, societal, and scientific. Secondly, content includes quantity, uncertainty, and data, change and relationships, and space and shape. Lastly, process: namely formulating situations mathematically; employing mathematical concepts, facts, procedures, and reasoning; and interpreting, applying, and evaluating mathematical outcomes.

The definition of financial literacy has been mentioned in the previous sub-section. Financial literacy on PISA assessment has three domains to be assess, context, content, process. The domain context described personal or global situations where knowledge and understanding of financial literacy, namely education and work; home and family; individual and societal. Meanwhile, the domain process describes students' cognitive abilities in the context and content of financial literacy relevant to understanding, analyzing, evaluating, and selecting solutions (OECD, 2019). More specifically, processes in the financial literacy domain include identifying financial information; analyzing financial information and situations; evaluating financial issues; understanding and applying financial knowledge. Furthermore, the financial literacy content area is knowledge and understanding of financial context. PISA financial literacy contains four content areas: money and transactions, planning and managing finances, risk and reward, and financial landscape (OECD, 2019).

Recently, the OECD completed the 2021 literacy financial framework, which shows an intersection in the domains content of mathematics literacy and financial literacy as presented in Figure 6. Operationally, there are two main points in the intersection between mathematics literacy and financial literacy. The first point, basic arithmetic is mathematics literacy content contained in financial literacy. These basic arithmetic operations include addition, subtraction, multiplication, and division of integers, decimals, and percentages (OECD, 2019). The second point is applying financial knowledge to solve financial problems. The financial context presented everyday problems. An example: students are faced with a choice between an educational insurance product that provides some information about its policy and benefits and a traditional savings account. This case fosters critical thinking about the financial situation regarding choosing a product from the various products offered and understanding that certain financial decisions may have different consequences.



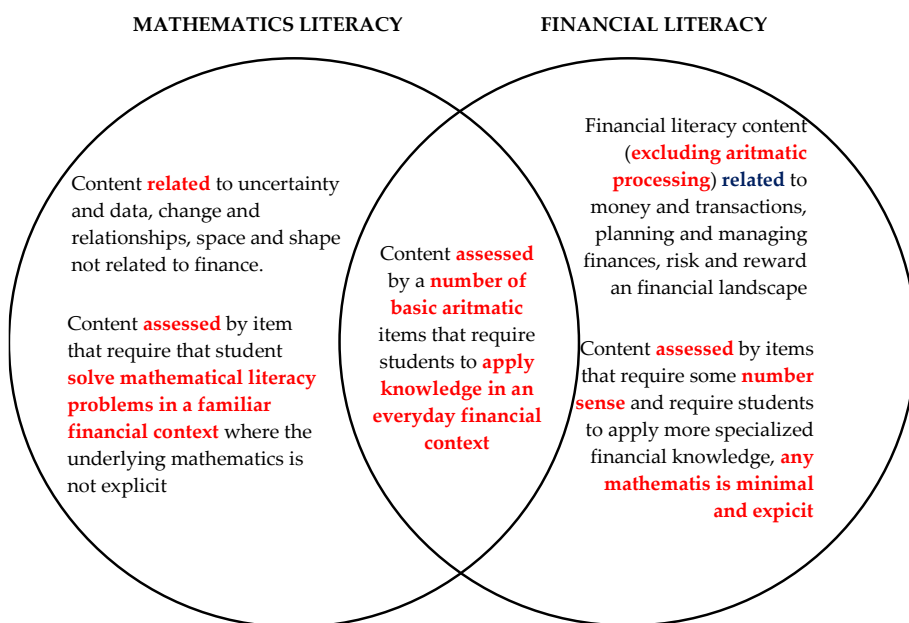


Figure 6. Relationship between the content of financial literacy and mathematical literacy

OECD explained that using formulas to solve financial problems in financial literacy assessment does not require algebraic skills. However, more complex financial problems require other mathematical content, such as quantity, uncertainty, and data, change and relationships, and space and shape. Ozkale and Erdogan (2020) found interaction between financial literacy and mathematical literacy, such as quantity, change and relationship, uncertainty and data, space, and shape. Dituri et al. (2019) combine financial education with mathematics course work in algebra topic. Savard (2022) taught financial concepts that emerged while learning about probability for grade 4 students. Another aspect from Skagerlund et al. (2018) found numeracy and the emotional attitude towards number as a central point of financial literacy.

Implementation of Financial Literacy in the Mathematics Curriculum

How to implement financial literacy in mathematics? The findings on bibliometrics concluded that financial literacy would be related to mathematics, numeracy, or mathematics literacy. In a while, the OECD stated intersection between mathematics and financial literacy is basic arithmetic for 15 years old. These basic arithmetic operations include addition, subtraction, multiplication, and division of integers, decimals, and percentages (OECD, 2019). OECD emphasized that using formulas to solve financial problems does not require algebraic skills. We stand behind OECD in financial literacy only in primary and secondary schools. However, financial literacy not only requires basic arithmetic skills but also requires broader mathematical concepts. High-level mathematical content is used in completing financial content (Dituri et al., 2019; Ozkale & Erdogan, 2020; Savard, 2022). For example, the idea of exponents calculating compound interest and derivatives to determine the minimum and maximum functions. The second point is applying financial knowledge to solve financial problems. The financial context presented can be



everyday problems that have been or will be faced by students. An example is when students are faced with a choice between an educational insurance product that provides some information about its policy and benefits and a traditional savings account. This case fosters critical thinking about the financial situation in terms of choosing the financial product from the various products offered and understanding that certain financial decisions may have different consequences.

OECD uses three domains of content, context, and process in assessing financial literacy and mathematical literacy. In our opinion, learning design can use the three domains as a reference. In this discussion, we will divide three domain formulations of content, context, and process in applying financial literacy to learning mathematics.

The content dimensions set by the OECD in the financial literacy framework consist of money and transactions; risks and rewards; planning and managing; and financial landscape (OECD, 2019). More specifically, an institution that provides financial courses for school age (4th grade, 8th grade, and 12th grade) contains six financial contents, namely earning income, spending, saving, investing, managing credit, and managing risk (JumpStart, 2021). A specific and in-depth study was conducted by Amagir et al. (2018) found literacy content at the secondary school level focused on content related to shopping and credit, savings and investment, budgeting, banking services, insurance, income, and careers. Financial literacy content based on studies measuring the level of personal financial literacy for high school students. These contents include income, programming and money management, credit, debt, saving, and investment (Helen, 2020). Different viewpoints in the Interaction Model of Mathematics and Financial Literacy (IMMFL) framework which combines mathematical content (quantity, change and relationships, space and shape, uncertainty, and data) with financial content financial literacy in the PISA assessment (Ozkale & Erdoğan, 2020). However, the IMMFL framework does not specifically explain the financial literacy content used.

Our article presents content dimensions that can be used in applying financial literacy as part of mathematics material. We have similarities with Ozkale and Erdogan (2020) in the mathematical content used, including quantity, change and relationship, space and shape, and change and relationship. Table 2 presents the specific mathematical content that we formulate to implement financial literacy.

The difference lies in the financial literacy content used. Financial literacy content contains content appropriate to financial activities carried out by high school students (Sole, 2017), including money and transactions, spending, and saving, investment, managing credit, and financial awareness. These two contents must be related to each other, for example when students are faced with the choice of buying pizza through a delivery order or visiting a store in person. Of course, when you visit the store in person, you are not charged with shipping costs, but you must take the time to visit the store. Delivery order services, of course, will add to shipping costs and possibly other costs. In this case, the students learned to calculate the tax percentage of pizza purchases they made. In addition, students learn to make effective decisions according to their needs, namely choosing to spend less money but extra time, or choosing to spend more money but being able to complete other work. This case teaches percentages and introduces students to financial awareness.

Table 2. Mathematics content in the mathematics learning process

Mathematics Content	Subject
---------------------	---------



Quantity	Integers, rational and irrational numbers, decimal, arithmetic operations on real numbers, scale, proportion.
Change and relationship	Algebra, commutative, associative, distributive, relation and function, nonlinear functions of graphically linear functions, linear equations and inequalities, rate of change
Space and Shape	Prisms, cylinders, pyramids and cones, congruence and similarity in triangles and quadrilaterals, reflection, translation, rotation, and dilation, lines, and plane
Change and relationship	Bar charts, pie charts, sample, population, mean, median, modus, range of the data to solve problems in a simple experiment

Furthermore, the context dimension describes personal to global situations where knowledge, skills and understandings from financial literacy are used. OECD (2019) confirms that a decision regarding financial matters often depends on the context or situation in which they are presented. The context used in the PISA assessment serves as a medium for problems that can make it possible to connect different individual roles in the real life around them. We present the same context as the context identified for PISA financial literacy, including education and work, home and family, individual, and societal.

Lastly, the process dimension. The process of financial literacy describes students' cognitive abilities to recognize and apply relevant concepts to understand, analyze, evaluate, and choose solutions. Cognitive processes in financial literacy are divided into four activities: identifying financial information, analyzing financial information and situations, evaluating financial problems, and applying financial knowledge and understanding (OECD, 2019; Lusardi, 2015). In contrast to Ozkale and Erdogan (2020) formulating a process dimension in IMMFL based on processes in the mathematical and financial literacy literature, including identifying financial situations, reasoning, problem-solving and modeling, manipulating, and estimating, reflecting and transferring, representing, using technology and communicating.

In our view, the verbs used in the financial literacy process are like the cognitive structure of Bloom's Taxonomy, namely remembering, understanding, applying, analyzing, evaluating, and creating. The fundamental difference is that cognitive in financial literacy is parallel or does not have a hierarchy, the sequence of processes presented in financial literacy is related to the sequence of thought and action processes, not a sequence of difficulties or challenges (OECD, 2019). Bloom's taxonomy creates a two-dimensional framework separating cognitive processes and knowledge and can be used flexibly by focusing on one or more pieces of knowledge together (Anderson & Krathwohl, 2001). Adopting the Revised Bloom's Taxonomy makes it easier to formulate skills that will be produced in learning mathematics and financial, which we use in formulating process dimensions presented in Table 3.

The financial literacy process of applying financial knowledge and understanding is adjusted to Bloom's Cognitive Revision stage into two different processes: applying financial knowledge and understanding financial information and mathematical concepts. In addition, this separation was carried out based on Savard and Cavalcante (2020) stating that knowing is not enough, to apply knowledge in life requires understanding.

Table 3. The relationship of revised bloom's taxonomy to the dimensions of the financial literacy process

Process	Competencies
---------	--------------



Remember	Recognize information that has been learned or known before, such as definitions, facts, sequential lists related to student financial activities and mathematical concepts
Understand	Explaining a financial concept using its own sentence, interpreting, concluding mathematical concepts that are related to a financial problem
Apply	Apply mathematical concepts, knowledge, or information to relevant financial situations
Analyze	Exploring the relationship/correlation between mathematical concepts, determine the relationship between the concepts in the relevant financial situation
Evaluate	Make decisions, systematically evaluate the completion of cases/projects undertaken
Create	Assemble a variety of financial knowledge in the search for project ideas and the ability to add value to an existing product.

(Adaptation: Radmehr & Drake, 2019; Tim, 2022)

Therefore, we use terminology mathematics literacy becomes more general for all school levels. Figure 7 presents the interrelationships between financial and mathematical literacy domains. Financial and mathematic literacy have three main domains: context, process, and content (OECD, 2019).

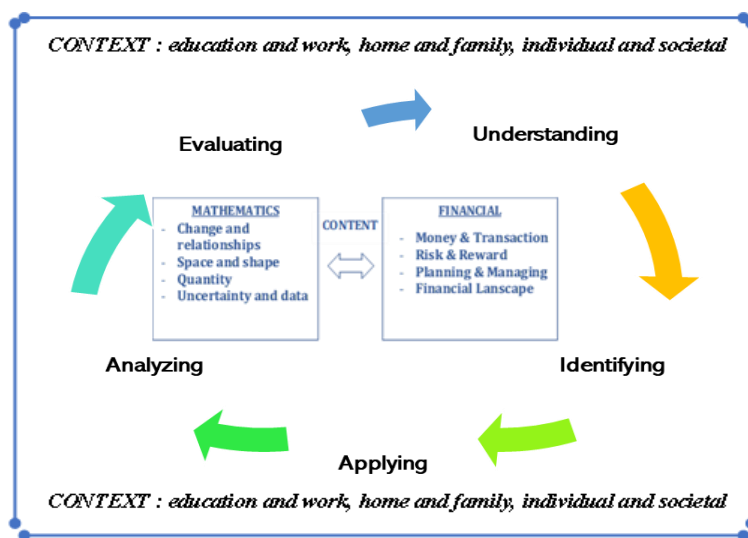


Figure 7. Framework financial literacy in mathematics classes

To complete our conceptual framework, we discuss the implementation of Project-Based Learning (PjBL) as a learning model in the classroom. Eickholt et al. (2019) stated that PjBL is authentic and realistic method for student-centered learning. In mathematics classes, PjBL emphasizes the application of mathematics in an interdisciplinary, holistic approach, integrated with practice and complex problems in the real world, where students must be able to carry out investigations to understand and product oriented (Kokotsaki et al., 2016; Rahayu & Putri, 2021). The projects in PjBL are related to student's culture and daily life problems (Markham, 2012; Jalinus et al., 2017; Eickholt et al., 2019; Oguz-Unver & Arabacioglu, 2014), which financial context being an activity that students experience daily.



On the other hand, using PjBL results in a broader and deeper student understanding of a topic and increased motivation to learn (Bell, 2010). In addition, a uniqueness of PBL is the construction of the final product, a 'concrete artefact' that represents students' new understanding, knowledge, and attitudes regarding the problem under investigation (Helle et al., 2006). To present the project using videos, photographs, sketches, model reports and other collected artefacts (Holubova, 2008). Figure 8 shows the modified PjBL syntax groupings in this study. The three main stages of PjBL in the learning process are initial material, project work, and evaluation.



Figure 8. The PjBL's stage in Mathematics Classes

Referring to Imafuku et al. (2014) and Jalinus et al. (2017) the following activities are carried out at each stage, presented in Table 4.

Table 4. The PjBL stage activity on the application of financial literacy in mathematics learning

PjBL Stages	Class Activity
Initial material	1. Determine the project. In this step students determine the topic of the project based on the assignment given by the teacher.
Project Work	2. Project step planning. Design a project step plan according to financial literacy content
	3. Arrange the schedule. This step describes how long the project must be completed step by step.
Evaluation	4. Teacher monitoring. Implement projects based on financial literacy content activities in completing project assignments.
	5. Preparation and Presentation of Reports. At this stage students compile reports / products that have been made. After that, students appear in front of the class to present their work.
	6. Project evaluation. Students are allowed to bring their experiences while completing project assignments. At this stage, feedback is also provided on the processes and products that have been produced. At this stage the teacher can give several questions to students to measure student understanding.

Finally, PjBL's interdisciplinary and holistic learning model is appropriate for implementing financial literacy in the mathematics curriculum. Mathematical material can be applied interdisciplinary with financial literacy. Through PjBL, students carry out complex practices' problems in the real world and investigations to understand and be product-oriented (Imafuku et al., 2014; Oguz-Unver & Arabacioglu, 2014).

We have conducted a preliminary survey of mathematics teacher knowledge in implementing mathematics learning, including financial literacy. The sample survey is a school that implements an independent curriculum in Yogyakarta Province. The results show that 66.67% of mathematics teachers use the financial context in learning, such as in social arithmetic material and exam questions. Moreover, teachers rarely provide knowledge and attitudes about financial in learning mathematics, such as the



purpose and use of money, needs and desires, ways of making payments, consumer awareness, changes in the value of money over time, investing in the stock market. This is in line with the teacher's level of knowledge in financial terms which is still lacking. Of the 17 terms we present, only four terms are familiar to teachers. The following table 5 summarizes the teacher's answers. Meanwhile, all schools have been equipped with financial books in the school library, but do not yet have a teacher's book on learning financial literacy in mathematics.

Table 5. Teacher financial literacy knowledge

Financial Terms	Never heard of it	Heard of it, but I don't recall the meaning
Salary	100%	
Wage	100%	
Income Tax	100%	
Budget	100%	
Pension Plan	100%	
Insurance	100%	
Investment	100%	
Saving	100%	
Bank Loan	100%	
Compound Interest	75%	25%
Exchange Rate	100%	
Depreciation	25%	75%
Stocks	100%	
Credit Card	100%	
Currencies	100%	
Gross Domestic Product (GDP)		100%
Consumer Awareness	75%	25%

Next, we surveyed school readiness in implementing PjBL, specific to a project on financial literacy. Of the 10 question items that contain school characteristics, project-based learning support systems, the application of an independent curriculum, and the application of financial literacy in learning, we grouped two types of schools. First, six out of 10 schools are in the "early stages", meaning that less than 50% of the teachers in these schools have implemented project-based learning. Meanwhile, four out of 10 schools are in the "developing stage", meaning that schools have good readiness to implement project-based learning. Schools in our sample's developing stage have implemented entrepreneurial-based learning and implemented project-based learning for more than two years. Based on this survey, we conclude that schools are ready to implement mathematics learning that integrates financial literacy through project-based learning.

Mb bisa tambahkan analisis dari hasil survei yang mb peroleh di atas dengan membandingkan dengan sejumlah penelitian. Kenapa hasil pengumpulan data nya bisa begitu dan bagaimana kontribusinya buat penelitian mb berikutnya. 1 paragraf aja. Sebagai penutup.



CONCLUSION

This research further discovered the intertwined concept between mathematics, financial literacy, and numeracy through the visualization of a thematic map created using the Bibliometrix R-Package. The intertwined concept, in this case, is obtained based on themes that often occur and support and affect each other. The findings offered financial literacy skills through PjBL in the mathematics school curriculum. Three-dimensional formulations need to be considered in the preparation of learning tools. The formulation of this dimension is an intersection of mathematical and financial content. The context uses the formulation in the PISA assessment of financial literacy. The process uses the Bloom's cognitive stage. The results of this study can also provide a new interdisciplinary study of mathematics learning in financial investigations. So, problems or math problems that use an economic context, especially in Finance, are not just a camouflage context that seems traditional. For example, when studying percent material, students are not only asked to calculate discounts on an item, but students are also given knowledge about what and how discounts can occur. However, this study has several limitations, including only discussing descriptively the empirical evidence of the link between mathematics and financial literacy found in previous studies. The framework for financial literacy in mathematics through PjBL is not yet at the practical implementation stage. Thus, the potential effect on students' financial literacy skills has yet to be discovered. Therefore, future research needs a study on developing the learning environment in mathematics classes along with learning tools, project activities, and assessments.

Commented [R14]: Belum menceritakan hasil dan analisis data tambahan yang di bagian akhir diskusi.

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Declarations

- Author Contribution : All authors contributed to the study conception and design. The idea for the article were performed by LS and RIIP. Furthermore, the first draft was written by LS and RCIP and the critically revised of the manuscript was written by ZZ and RIIP. Lastly, the literature search and data analysis were performed by LS and RIIP. All authors read and approved the final manuscript.
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