Journal of
Education and Practice
(JEP)

Variables Affecting 21st Century K-12 Students' Mathematics Achievements: A Systematic Review

CARI Journals

Journal of Education and Practice
ISSN 2520-467X (Online)
Vol.8, Issue No.1, pp 13 – 31, 2024
www.carijournals.org

Variables Affecting 21st Century K-12 Students' Mathematics Achievements: A Systematic Review

Isaac Gyan Ayeh
Lutrill & Pearl Payne School of Education, College of Human Sciences & Education
Louisiana State University
https://orcid.org/0009-0007-8346-0465

Accepted: 1th Dec 2023 Received in Revised Form: 28thDec 2023 Published: 12th Jan 2024

Abstract

Purpose: This study aimed to use a systematic review of factors affecting K-12 mathematics achievement in the 21st century using only peer-reviewed articles published from 2012 to 2022.

Methodology: A systematic literature review of factors affecting K-12 mathematics achievement in the 21st century using only peer-reviewed articles published from 2012 to 2022. The Boolean search approach was employed to gather articles from electronic research databases. Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) were used to select a final of 65 articles for the study. A total of 33 axial codes were identified as specific factors from the systematic review conducted.

Findings: Analysis of the research questions showed a high percentage of the articles conducted in Europe, North America, and Asia, with fewer publications on other continents. The findings showed low published research articles in the era of the COVID-19 pandemic. A final review of the 65 articles uncovered a total of 32 axial codes as the specific variables affecting K-12 students' mathematics achievements. These axial codes include gender, socioeconomic status, teacher qualification, and class size.

Unique Contribution to Theory, Practice, and Policy: While many of these studies have found students, teachers, and schools-related variables as predicting or affecting students' mathematics achievement, comprehensive research into the specific factors within the identified variables is less researched. This study will bridge this gap and contribute to the research and academic resources pool. Governments and other education stakeholders worldwide can use the findings from this study as a guide in making decisions and improving learners' academic standards.

Keywords: *Mathematics, Mathematics Achievement, Student-Related Variables, Teacher-Related Variables, School-Related Variables*.

1. INTRODUCTION

In finding achievable ways to improve mathematics achievement among students globally, scholars, policymakers, and educators have conducted several research studies on mathematics teaching and learning. In recent studies, attention has focused on teaching methods, instructional goals, theories of student learning, and the nature of mathematics to improve students' mathematics achievement by considering possible variables related to students, teachers, parents, and schools. Consistent data gathered by the Program for International Student Assessment (PISA) and other research bodies engaged in comparing students' achievement in mathematics findings from several nations reveal severe and ongoing academic failures in mathematics. Many of the findings from these research studies have portioned a high percentage of the causes of students' failure in mathematics to students, teachers, parents, and school factors.

1 Students' Mathematics Achievements

According to Prestwich (2015), "Researchers have explored the school systems of other nations, such as Japan, China, and Singapore, whose students continue to achieve high in international assessments in mathematics to understand the reasons for their success (Ma, 1999; Stevenson & Stigler, 1992; Stigler & Hiebert, 1999)". International research bodies such as the Trends in International Mathematics and Science Study (TIMSS) and the National Center for Educational Statistics ((NCES), 2016) have found that students continue to trail in mathematics-related subjects. Again, as evidenced by the National Council for Teachers of Mathematics (NCTM), the Principles and Standards for School Mathematics by Ferrini-Mundy (2000), and the National Mathematics Advisory Panel (2008) publications, effective mathematics instruction worldwide has been the focal point in mathematics curriculum and educational reforms over the past two decades.

Investigating student, classroom, and school variables affecting mathematics performance in the US and Australia, findings evident in Lamb & Fullarton's (2001) study using secondary data from TIMSS indicate that classroom variations in Australia and the US account for more than one-quarter of the variation in pupil performance. The school makeup and organizational variables were primarily to blame for the variation in the classroom. International comparison studies between countries on student and school factors influencing mathematics performance have investigated different variables at pupils, teachers, and school levels influencing students' mathematics success. The findings of these studies indicate various trends in the relationships between mathematics success and student and school-level indicators in the three nations.

1.2 Variables Affecting K-12 Students' Mathematics Achievements

1.2.1 Student-level variables

According to Lindberg et al. (2010), there are differences in performance and access to mathematics classes between genders in middle and high schools. Gender differences in reading and writing narrow as the student progresses through primary education, as found in a study conducted by Ganley and Lubienski (2016). However, gender differences widen in mathematics,

with male scores increasing compared to girls upon completing first grade. Girls show more mathematics anxiety and apprehension than boys, which had a detrimental impact on their mathematics performance, according to a study of an analyzed data set (Ganley & Lubienski, 2016). Researchers have found that males and females sometimes use mathematics problem-solving differently. Boys use more creative methods, and girls are more likely to use teacher-recommended techniques and depend on the teacher for guidance on how to get started in solving mathematics problems (Zhu, 2007). Technology advancements over the past few years have made computers and associated technologies more affordable and complex. Because of this, families are able and ready to purchase computers for their kids, allowing them to develop into proficient computer users. A similar study conducted by Aubrey et al. (2006) using longitudinal mathematical data in Britain found that students' prior mathematical competencies and skills strongly impact students' later achievement in mathematics. Many studies have been conducted to identify factors contributing to students' mathematics achievement.

1.2.2 Teacher-level variables

Teachers are crucial to the academic success of students. The discovery that teacher instructional practices are related to student mathematics performance necessitates actions to reassure teachers that how they present the subject matter of mathematics in their classes does influence the success of their students. Teachers' years of employment are typically the yardstick to measure teachers' expertise or competencies in teaching. The results of mathematics test scores collected by the National Assessment of Educational Progress (NAEP) from the 50 US states revealed that teacher expertise's impacts on student success vary based on teacher efficacy (Darling-Hammond, 2000). Kini and Podolsk (2016) discovered that the early ten years of a teacher's instructional responsibility saw the most significant difference between years of teaching and pupil performance. The findings indicate that the first decade of teachers' instruction is when they will see the most significant differences in pupil achievement. This means that teachers are more productive in their early teaching life than in later years, where their output tends to balance off. Research has shown that teachers' educational backgrounds substantially impact students' academic performance. Several teacher-related factors that impact learners' mathematics achievement need to be unraveled in similar studies to the few discussed.

1.2.3 School-level variables

Much work on classroom and school factors on students' academic achievements has indicated that the school variables also impact students' mathematics achievement. However, there is a large part of the variation. Using available data, Lamb and Fullarton (2000) found that "in Australia, while student background variables influence differences in achievement in mathematics, school variables also contribute substantially." Class sizes refer to the number of pupils a teacher teaches at a particular time, which benefits teachers and students and results in higher student achievement. Educators have consistently decreased the classroom size, believing smaller classes will improve

student performance. The number of students in a teacher's class impacts their interaction with pupils Finn & Shanahan, (2016). For instance, class size affects how much time a teacher spends identifying and addressing the requirements of individual students in the classroom pupils (Ehrenberg et al., 2001). In several studies, socioeconomic standing is a reliable indicator of academic success. Lower SES settings stress people significantly, impairing selective focus and affecting students' performance (Farah & Hackman, 2012). It is worth noting that many disadvantaged students succeed at school, and the socioeconomic status of students is a significant factor in the differences in countries' performances in all subjects, including mathematics.

2. METHODOLOGY

This systematic review study employed the mixed-method methodology to find answers to the research questions guiding this study. The quantitative method ensured an effective approach to aggregating the articles' data. A qualitative method of priori coding was also used to code the findings from the reviewed papers. Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P; Shamseer et al., 2015), which facilitate the creation and reporting of Systematic Reviews and Meta-Analysis, were used as a guide for conducting an effective and rigorous search of relevant articles included in this study.

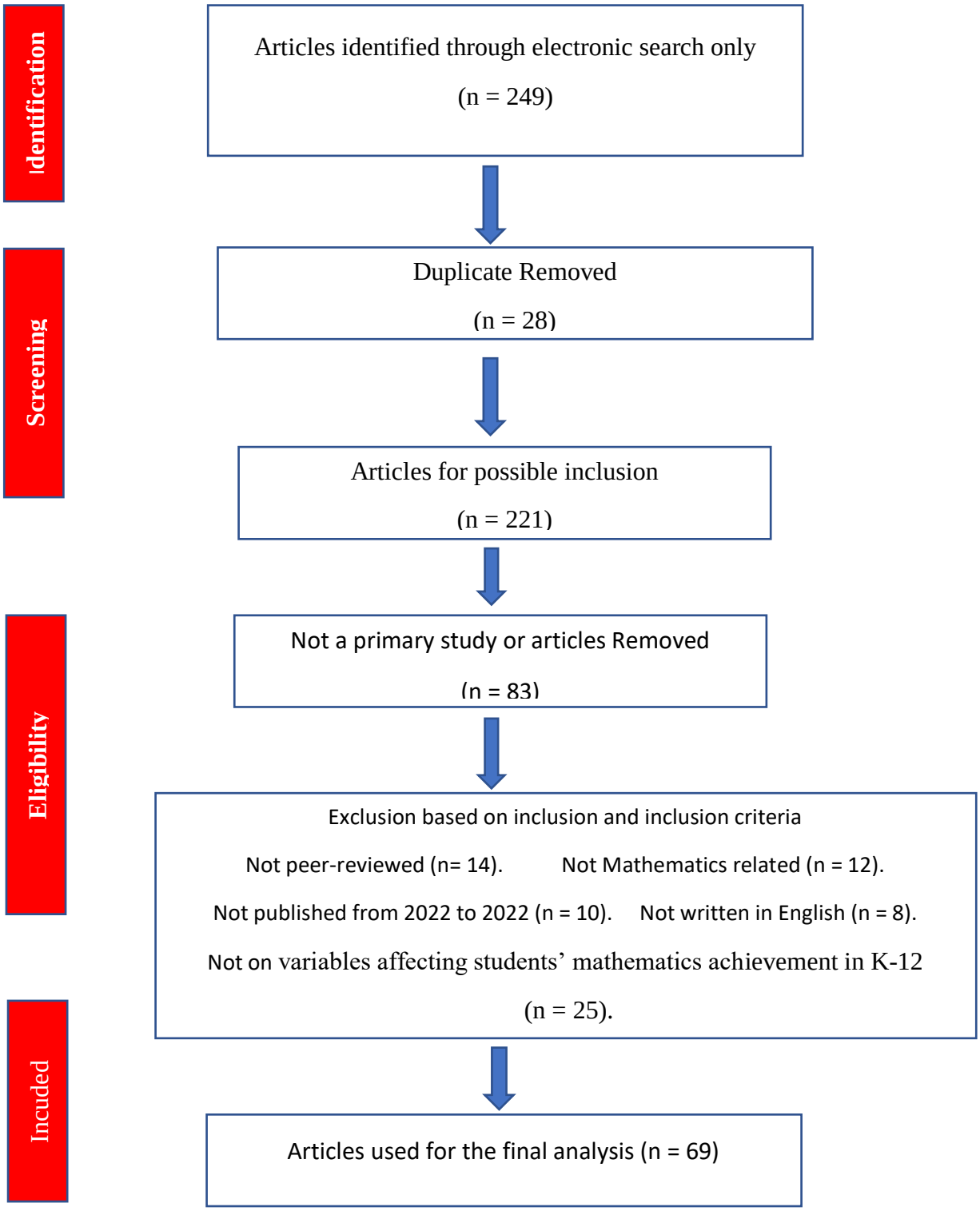

Figure 1: PRISMA-P flow chart of the article screening method.

2.1 Purpose of the Study

This study aims to give researchers and practitioners a better understanding of the specific identified factors or variables that affect K-12 students' mathematics achievement in the 21st century. Focusing on research conducted on specific variables affecting students' mathematics achievements. Four sub-questions further enhance the research study:

1. What methodologies were used in the variables Affecting 21st Century K-12 Students' Mathematics Achievements research?
2. Are there any trends in the geographical locations and years of research publications on variables Affecting 21st-century K-12 students' Mathematics Achievements research?
3. What level of K-12 education were the variables Affecting 21st Century K-12 Students' Mathematics Achievements research published?
4. What specific variables were identified to be affecting 21st-century K-12 students' mathematics achievement?

2.2 Adopted Article and Searching Approach

The study used only selected articles from 2012 to 2022 for this systematic review to collect articles published within a decade of work in K-12 students' mathematics achievement. Only primary and peer-reviewed journal articles were selected for this systematic review as this approach increases the trust in gathered research articles (Gough & Richardson, 2018).

Only electronic data retrieval was used to gather the needed articles for the study. The articles were retrieved from different databases using a full-text data search. These databases include Wiley Online Library, JSTOR, Science Direct, Research Gate, and other databases within EBSCOhost (Academic Research Complete, Google Scholar, etc.). The Boolean search approach was used to search for the data using keywords related to students' mathematics achievement and variables or factors affecting students' mathematics achievements.

Table 1: Boolean Search approach

Search items	Search terms used.
Search 1	"Student variables" OR "Pupils variables" OR "Learners variables" OR "Student factors" OR "Pupils factors" OR "Leaners factors" "Teacher variables" OR "Instructors variables" OR "Educators variables" OR "Teacher factors" OR "Instructors factors" OR "Educators factors" "School variables" OR "Institution variables" OR "College variables" OR "School factors" OR "Institution factors" OR "College factors"
Search 2	"K-12" OR "High school" OR "Middle school" OR "Elementary school" OR "Grade 1-12" OR "Class1-12" OR "Level 1-12" OR "1st -12th Grade" OR "1st -12th Class" OR "1st -12th Level"
Search 3	"Mathematics achievement" OR "Mathematics performance" OR "Mathematics increment" OR "Mathematics improvement"

2.3 Articles Inclusion and Exclusion Criteria

A total of 249 articles were electronically gathered as possible inclusion articles for the study. Of the 249 articles compiled, 28 duplicates were removed, reducing the number to 221. 83 articles that were not primary research were also removed to reduce the number to 138 for possible inclusion. Each of the remaining 138 articles was examined to be a peer-reviewed article, a mathematics-related article, an article on variables affecting students' mathematics achievement in K-12 only, an article published from 2012 to 2022, and an article written in English to qualify for the inclusion criteria. Articles that do not fall within the inclusion criteria were rejected to reduce the number of articles to 69. With the assistance of other graduate students and mathematicians, the researcher reviewed each article at two different times to ensure consistency of measurement with interrater reliability of 95%.

Table 2: Inclusion and Exclusion criteria of articles

Inclusion criteria	Exclusion criteria
• **Peer-reviewed articles** • **Mathematics-related articles** • **Articles published from 2012 to 2022** • **Articles on K-12 only** • **Articles that are written in English language only** • **Articles on variables affecting students' mathematics achievement in K-12 only**	• Conference papers • Editorial papers • Articles on variables affecting students' mathematics achievement below or above K-12 level

2.4 Method of Coding

To analyze the data from the articles, "A priori" coding was used to answer the research questions that guided the study. Priori codes are codes developed before examining the current data to reflect concepts from literature. The data were coded into student-related, teacher-related, and school-related variables as the identified variables found in many pieces of literature. Grounded coding was also used to gather the specific variables affecting K-12 students' mathematics achievement as described by the primary researchers. Through rigorous scrutiny, deductive and inductive approaches, and the breaking down of the initial codes, axial codes were created to relate the specific variables to the categories of variables used for the priori coding.

3. RESULTS AND FINDINGS

The findings of this study and its discussions are presented according to the research questions outlined in the study.

3.1 Research Question 1:

What research methodologies were used in the variables Affecting 21st Century K-12 Students' Mathematics Achievements research?

Researchers describe their research process using research methodology. Research methodology is a rational, methodical strategy for solving a research conundrum and also guarantees accurate, valid results that satisfy researchers' goals and objectives. Research methodology provides

sufficient knowledge for other researchers who want to do a similar study. The number of articles included in this study was grouped based on the authors' research methodology, which may be quantitative, qualitative, or mixed-method research methodologies. The data show that 90% of the articles used quantitative research methodology, 7% used mixed - methods, and only 3% used qualitative research methodology, as shown in Figure 2.

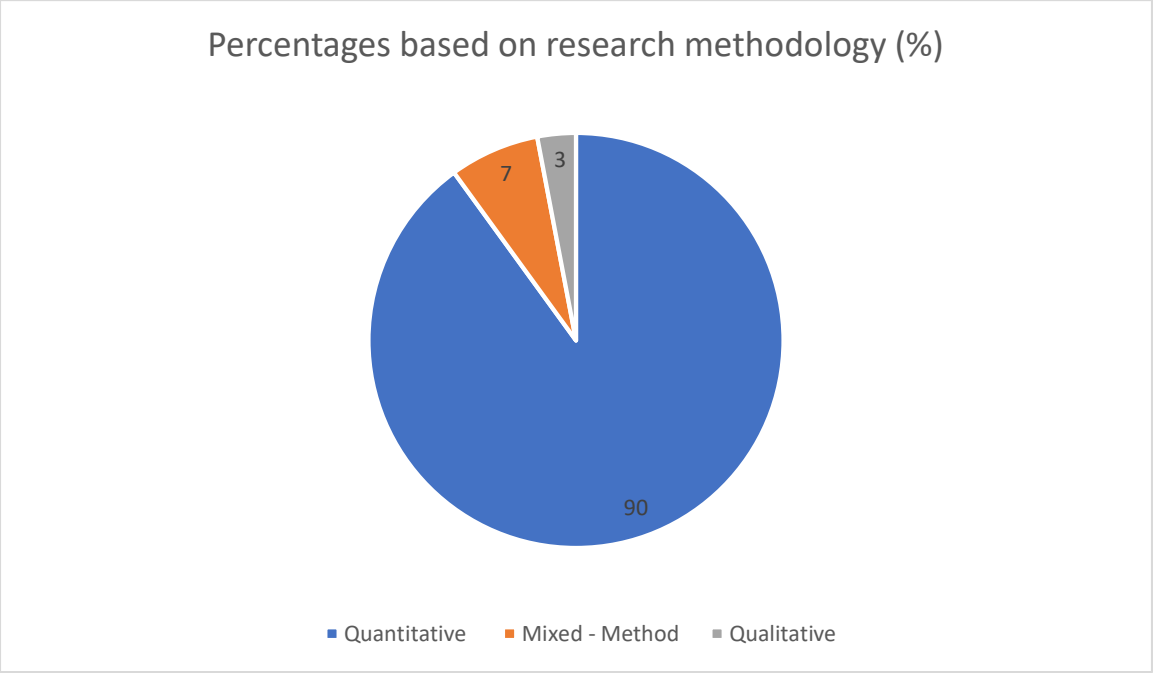

Figure 2: Articles distribution based on Research Methodologies

3.2. Research Question 2:

Are there any trends in the geographical locations and years of research publications on variables Affecting 21st Century K-12 Students' Mathematics Achievements research?

3.2.1 Geographical Distribution by Continent

Of the 69 articles used in this study, 63.77 % were done in North America, representing the continent where most articles were researched. Asia had 23.19 %, maintaining the second continent where most articles were published. Europe ranked third, with 8.69 % of the articles used in the study published. With only 4.34 %, Africa was identified as the continent with the least published articles. The trends identified in the percentage of published articles based on the continent may result from research grants available to writers from these continents.

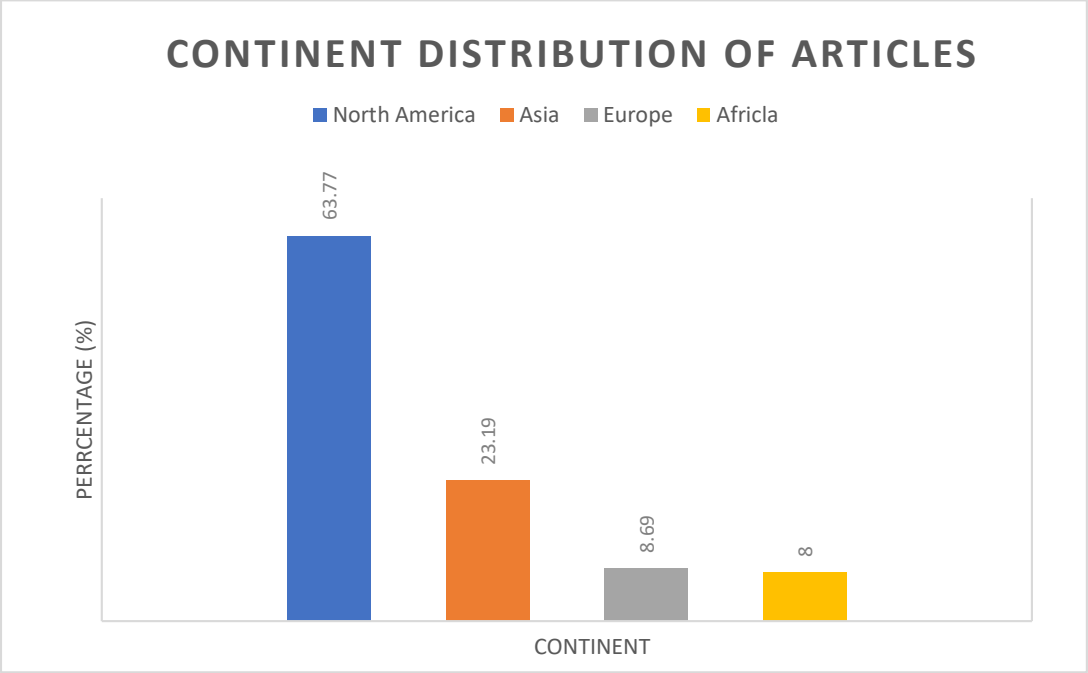

Figure 3: Articles distribution based on Continent

3.2.2 Year of article publication

The findings revealed that the years 2017 (19%) and 2018 (15%) have the most published research, whereas 2019 (4%) and 2020 (6%) have the least. There is no overarching trend of changes in the number of articles published within the remaining years. The few publications in 2019 and 2020 may be due to the COVID-19 pandemic, as researchers could not access human subjects for data collection and funding opportunities for research studies during those years. This is depicted in Figure 4.

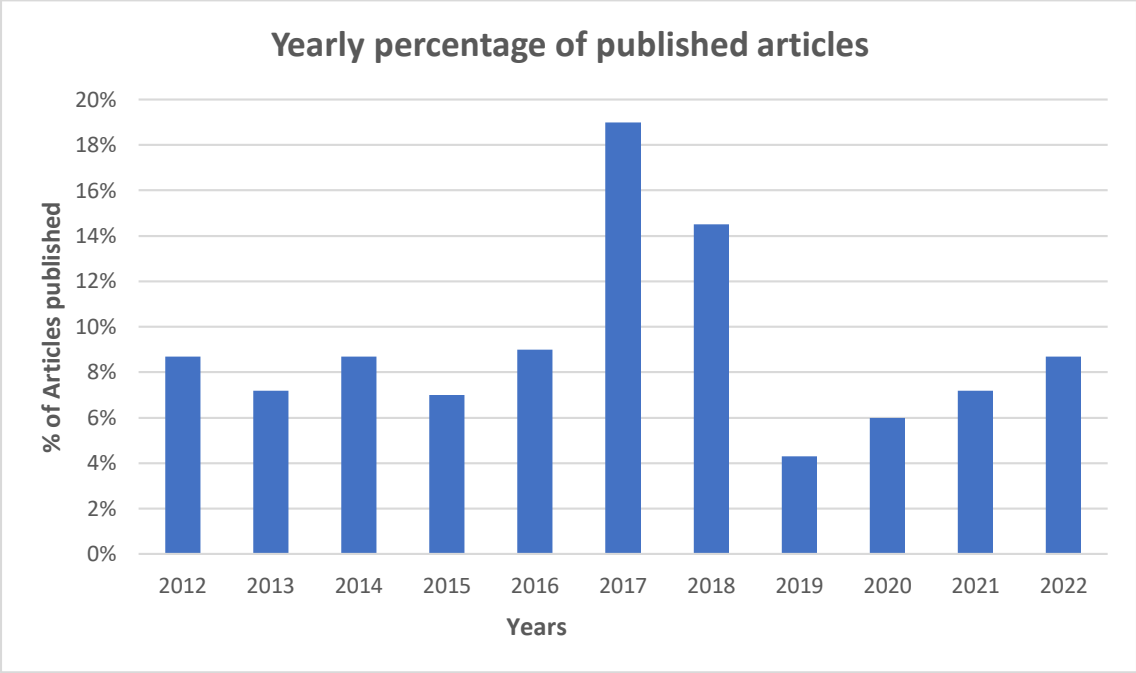

Figure 5: Articles distribution based on year

3.3. Research Question 3:

What level of K-12 education were the variables Affecting 21st Century K-12 Students' Mathematics Achievements research published?

Most of the articles included in this study were found to cover middle and high school mathematics curriculum. High school-level studies recorded the highest number of studies, with 33 articles. In contrast, the elementary level recorded the least number of articles of 11 published articles. From the articles gathered, it can be noticed that research on variables affecting students' mathematics achievement has been on the increase except for the COVID-19 pandemic years. After the pandemic outbreak, researchers have started conducting studies in this area, and there has been a steady increase year by year. The K-12 level of distribution is presented in Figure 5.

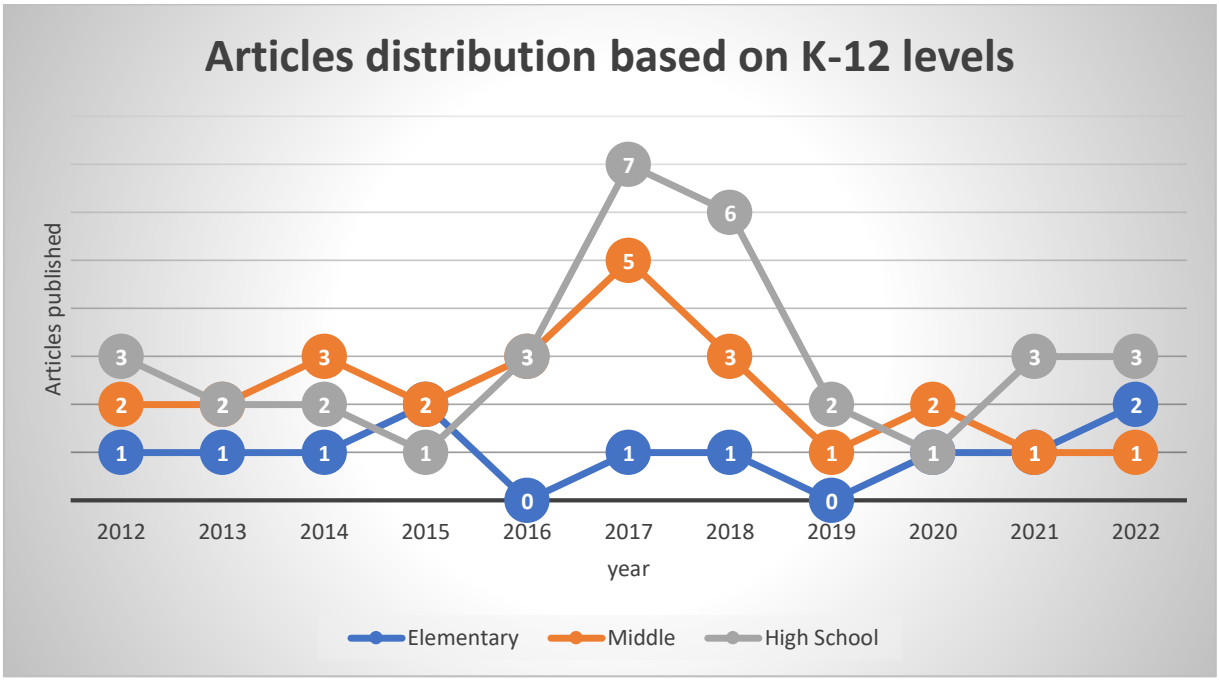

Figure 5: Articles distribution based on level of K-12 education

3.4 Research question 4:

What Specific variables were identified to be affecting 21st-century K-12 students' mathematics achievement?

From the priori coding of the articles used for the study, the three main variables affecting students' mathematics achievements in K-12 education in the 21st century were ***Student-related, Teacher-related, and school-related variables***. All the 69 articles used for this study fit into one, two, or all three categories of the variables. 14 were student-related, 9 were teacher-related, and 5 were school-related. 9 were only Student and Teacher -related variables, 8 were only Student and School-related variables, 6 were only Teacher and School- related variables, and 10 were both Student, Teacher, and school-related variables.

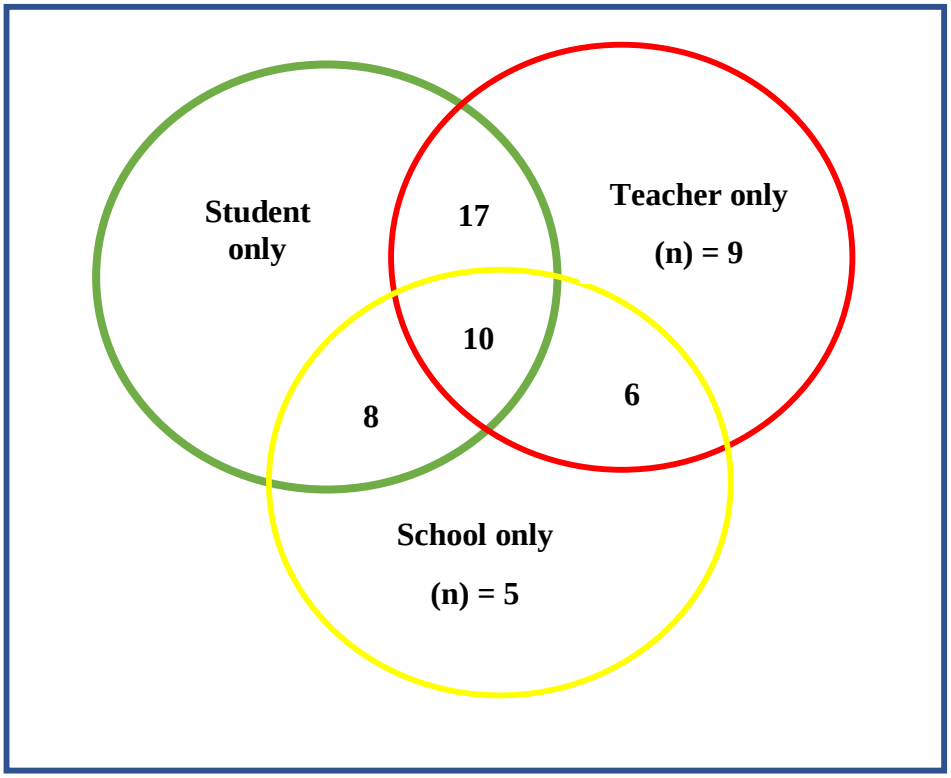

Figure 6: Articles distribution based on identified related variables

Further grounded coding revealed the three priori coding variables identified and their related total of 32 axial codes as the specific variables affecting K-12 students' mathematics achievements. The specific variables affecting K-12 students' mathematics achievements identified in the axial coding were similar to all levels, be it elementary, middle, or high school level.

3.4.1 Student-related variables

Student-related variables affecting students in K-12 mathematics achievement identified from the systematic review of articles data gathered for the studies found 13 axial codes. The articles that fall under the student-related variables are articles in which studies were focused on the extensive student factors that impact students' mathematics achievements. Some of these variables include students' attitudes toward mathematics, mathematics anxiety, prior mathematics achievement, and socioeconomic status of students. Students can show different attitudes towards mathematics, and negative attitudes tremendously affect their mathematics achievements.

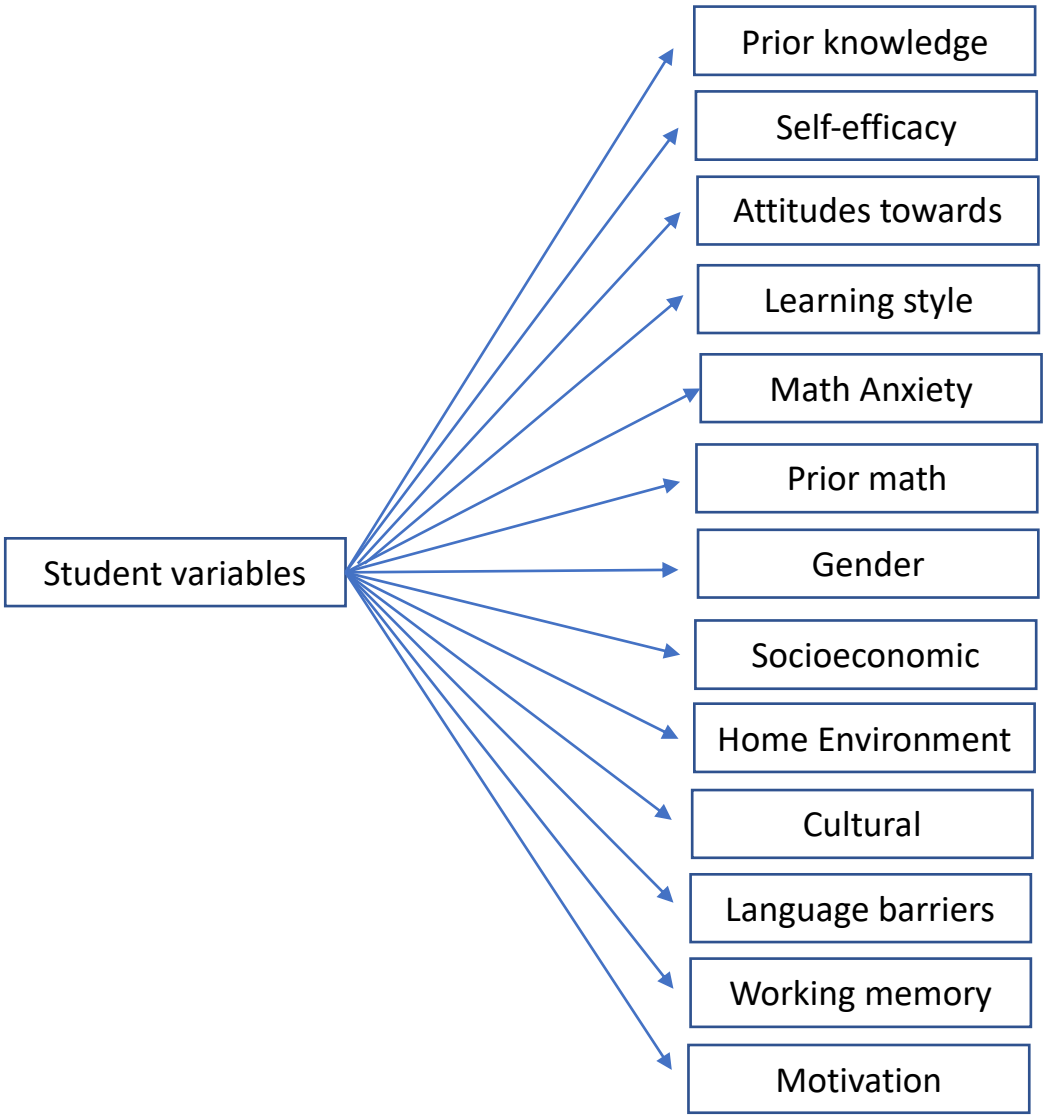

Figure 7: Axial codes of student-related variables

4.2 Teacher-related variables

In the grounded coding, teacher-related variables were the variables that focus on how the teacher activities impact the students' achievement, which saw the highest axial coding of 13 as the causes of K-12 students' mathematics achievement from the data gathered for the study. Some axial coding identified from the data under the teacher-related variables includes teaching methods, teacher content knowledge (TCP), teacher pedagogical knowledge (TPK), teacher qualification, teacher experience, feedback, and teacher professional development.

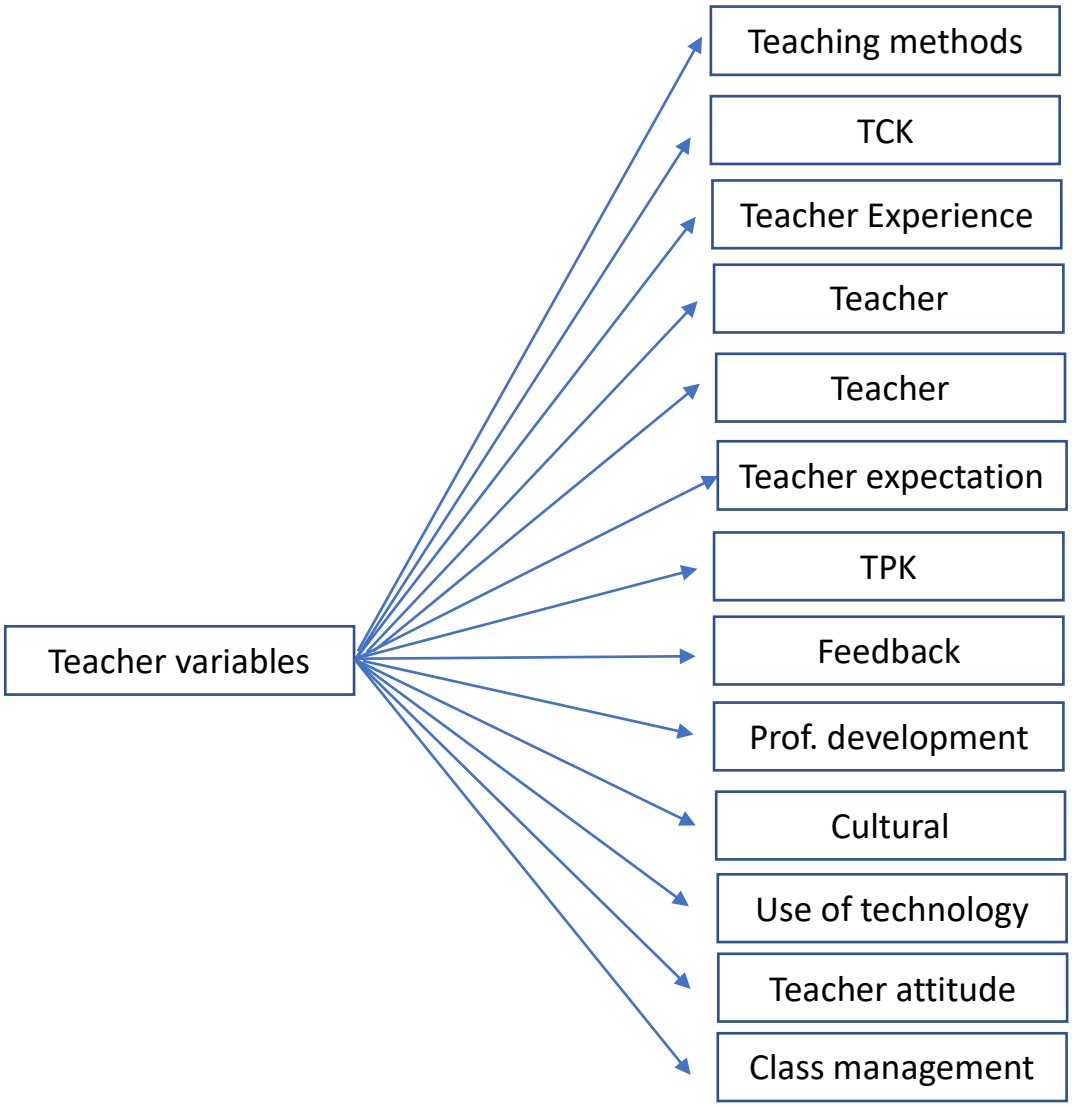

Figure 8: Axial codes of teacher-related variables

Table 4: Teacher-related variables axial code information and examples

3.4.3 School-related variables

The coding revealed six axial codes in the school-related variables, which are variably associated with school factors that impact students' achievements. The axial codes from the study's school-related variables include the curriculum, instructional resources, class size, parental involvement, school culture, and time spent on instruction.

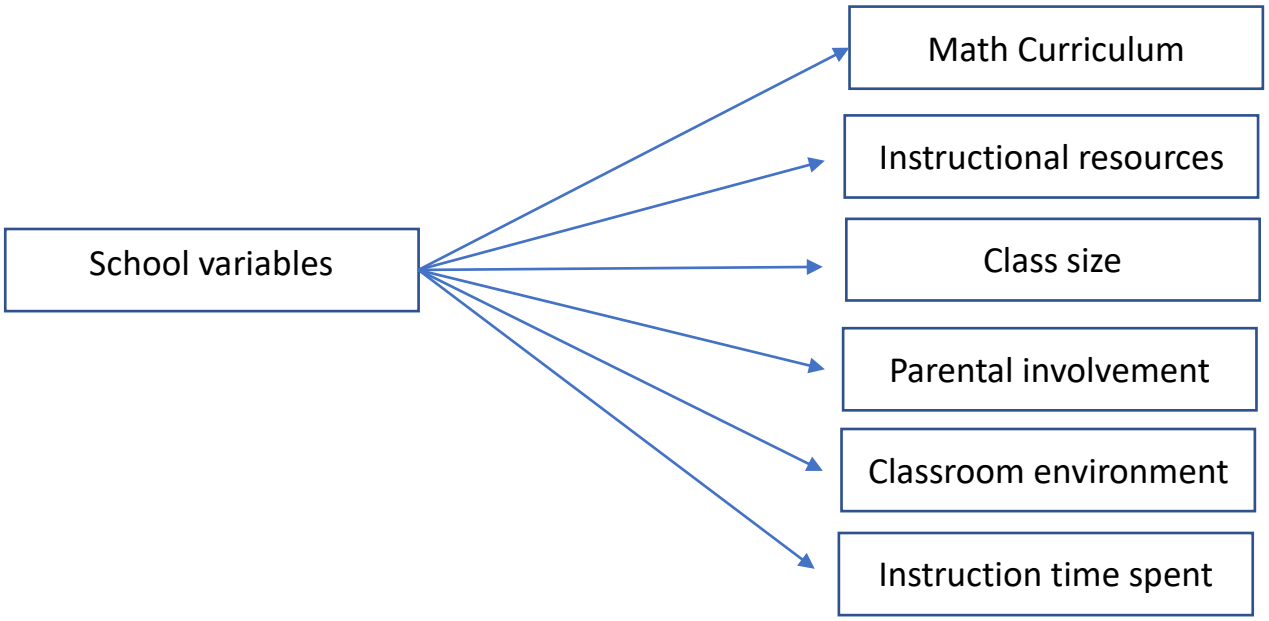

Figure 9: Axial codes of school-related variables

4. DISCUSSION

This study will give researchers and practitioners a better understanding of the specific identified factors or variables that affect K-12 students' mathematics achievement in the 21st century. The study findings show that 90% of the articles used quantitative research methodology, 7% used mixed - methods, and only 3% used qualitative research methodology. The high percentage of quantitative research articles may indicate a growing interest of mathematics researchers in conducting qualitative studies, which is evident in the study conducted by Barroso et al. (2021). A high percentage of the articles for this systematic review were also conducted in Europe, North America, and Asia, with fewer publications in other continents. The findings of the study also indicate that the years 2017 (19%) and 2018 (15%) have the most published research, whereas 2019 (4%) and 2020 (6%) have the least. Since 2019 and 2020 were the era of the COVID-19 pandemic, the few publications in these years may be due to the COVID-19 pandemic, which resulted in halting many academic activities and preventing researchers from accessing human subjects for data collection and getting funding opportunities for conducting research studies. Using grounded coding revealed the three priori coding variables as students, teachers, and schools-related variables, giving 32 axial codes as the specific variables affecting K-12 students' mathematics achievements. These specific variables affecting K-12 students' mathematics achievements in the axial coding run through all student levels, whether elementary, middle, or high school, and are more in number than those found in a similar study conducted by Polly et al. (2022).

Student-related variables identified 13 axial codes specifically affecting K-12 students' mathematics achievement. Some of these variables include students' attitudes toward mathematics, mathematics anxiety, prior mathematics achievement, and socioeconomic status of

students. Although students' socioeconomic status (SES) conditions may differ, the impact on students' mathematics achievement is enormous, as found in a study conducted by Lee and Borgonovi (2022). Many factors can significantly impact students' performance in mathematics, and this study has provided an extensive list of specific factors affecting K-12 mathematics achievement in the 21st century. Some axial coding identified from the data under the teacher-related variables includes teaching methods, teacher content knowledge (TCP), teacher pedagogical knowledge (TPK), teacher qualification, teacher experience, feedback and assessments, and teacher professional development. The impacts of teacher content knowledge (TCP) and teacher pedagogical knowledge (TPK) are similar to the findings of studies conducted by Campbell et al. (2014) and Charita and Aclan (2016), respectively, Finally, the coding revealed six axial codes as specific factors affecting K-12 mathematics achievement in the 21st century related to school variables. The axial codes from the study's school-related variables include the curriculum, instructional resources, class size, parental involvement, school culture, and time spent on instruction. Many of these variables and findings agree with the findings in a study conducted by Polly et al. (2022).

5. RECOMMENDATION

Researchers interested in conducting future research using systematic review could expand this study by including preschool and tertiary-level students. Other studies can also focus on identifying other variables and their specific factors affecting k-12 students' mathematics achievement, such as political influence and governmental policies. Researchers are encouraged to conduct similar studies using secondary data and longitudinal research. Secondary data, such as those provided by Trends in International Mathematics and Science Study (TIMMS) and PISA, is used to analyze the causality claims suggested by (Ma, 2021). Lastly, governments and other education stakeholders must make funding available for researchers interested in conducting extensive studies to provide valuable information to educators in making decisions and improving learners' academic standards.

6. CONCLUSION

This systematic review research study found that most articles on variables predicting students' mathematics achievement were conducted using the quantitative research approach; an example is Barroso et al.'s (2021) study. Some articles covered factors relating to students, teachers, or schools only. In contrast, others combine two or all the three priori coding variables identified in the study. Some of these variables include students' attitudes toward mathematics, mathematics anxiety, prior mathematics achievement, and socioeconomic status of students. Teacher-related variables include teaching methods, teacher content knowledge (TCP), teacher pedagogical knowledge (TPK), teacher qualification, teacher experience, feedback and assessments, and teacher professional development. School-related variables include the curriculum, instructional resources, class size, parental involvement, school culture, and time spent on instruction.

These findings show that educational stakeholders, policymakers, and mathematics curriculum developers must consider, address, and implement several measures related to students'

mathematics achievement to make informed decisions in handling students' mathematics achievement issues in education. These measures may include equipping mathematics classrooms with qualified and certified mathematics teachers, providing technology resources for learning mathematics, and teachers using innovative pedagogical approaches, as found in Saal et al.'s (2020) study.

Reference

Abdurrahman, M. S., & Garba, I. M. (2014). The impact on motivation on students' academic achievement in Kebbi State Junior Secondary School mathematics. *International Journal of Advance Research*, 2(12), 1-15.

Anderson, K. A. (2020). A national study of the differential impact of novice teacher certification on teacher traits and race-based mathematics achievement. *Journal of Teacher Education*, *71*(2), 247-260.

Ashim, B., & Ahmed, S. (2018). Effects of Parental Involvement on Secondary School Students' Mathematics Achievement in Assam, India. *Online Submission*, 3(7), 275–281.

Aubrey, C., Godfrey, R., & Dahl, S. (2006). Early mathematics development and later achievement: Further evidence. *Mathematics Education Research Journal*, pp. *18*, 27–46.

Barroso, C., Ganley, C. M., McGraw, A. L., Geer, E. A., Hart, S. A., & Daucourt, M. C. (2021). A meta-analysis of the relation between math anxiety and math achievement. *Psychological Bulletin, 147*(2), 134–168. https://doi.org/10.1037/bul0000307

Campbell, P. F., Nishio, M., Smith, T. M., Clark, L. M., Conant, D. L., Rust, A. H., & Choi, Y. (2014). The relationship between teachers' mathematical content and pedagogical knowledge, teachers' perceptions, and student achievement. *Journal for Research in Mathematics Education, 45*(4), 419–459.

Charita A. Luna, Emelia G. Aclan (2016). The Influence of Teachers' Mathematics Pedagogy Content Knowledge Training on Pupils' Mathematics Achievement. American Journal of Educational Research. Vol. 3, No. 10, 2015, pp 1311-1314. http://pubs.sciepub.com/education/3/10/16

Clotfelter, C. T., Ladd, H. F., & Vigdor, J. L. (2007). Teacher credentials and student achievement: Longitudinal analysis with student fixed effects. *Economics of education review*, *26*(6), 673-682.

Darling-Hammond, L. (2000). Teacher quality and student achievement. *Education policy analysis archives*, *8*, 1–1.

De Araujo, Z., Roberts, S. A., Willey, C., & Zahner, W. (2018). English learners in K–12 mathematics education: A review of the literature. *Review of Educational Research, 88*(6), 879-919.

Ehrenberg, R. G., Brewer, D. J., Gamoran, A., & Willms, J. D. (2001). Class size and student achievement. *Psychological science in the public interest*, *2*(1), 1-30.

Farah, M. J., & Hackman, D. A. (2012). SES, childhood experience, and the neural bases of cognition.

Ferrini-Mundy, J. (2000). Principles and standards for school mathematics: A guide for mathematicians. *Notices of the American Mathematical Society*, *47*(8).

Finn, J. D., & Shanahan, M. E. (2016). Does class size (still) matter? In *Class Size* (pp. 121-145). Routledge.

Ganley, C. M., & Lubienski, S. T. (2016). Mathematics confidence, interest, and performance: Examining gender patterns and reciprocal relations. *Learning and Individual Differences*, *47*, 182-193.

Gough, D., & Richardson, M. (2018). Systematic reviews. In *Advanced research methods for applied psychology* (pp. 63–75). Routledge.

Hassidov, D. (2017). The Link between Teaching Methods and Achievement in Math in Computer-Assisted Elementary Schools. *Creative Education, 8,* 2293–2311. Doi: 10.4236/ce.2017.814157.

Jourdain, L. V., & Sharma, S. (2016). Language challenges in mathematics education: A literature review.

Kini, T., & Podolsky, A. (2016). Does Teaching Experience Increase Teacher Effectiveness? A Review of the Research. *Learning Policy Institute*.

Kul, Ü., Celik, S., & Aksu, Z. (2018). The impact of educational material use on mathematics achievement: A meta-analysis.

Lamb, S., & Fullarton, S. (2001). Classroom and school factors affecting mathematics achievement: A comparative study of the US and Australia using TIMSS.

Lee, J., & Borgonovi, F. (2022). Relationships between family socioeconomic status and mathematics achievement in OECD and non-OECD countries. Comparative Education Review, 66(2), 199-227.

Lindberg, S. M., Hyde, J. S., Petersen, J. L., & Linn, M. C. (2010). New trends in gender and mathematics performance: a meta-analysis. *Psychological bulletin*, *136*(6), 1123.

Ma, L. (1999). *Knowing and teaching elementary mathematics: Teachers, understanding of fundamental mathematics in China and the United States*, Erlbaum, Mahwah.

McMeeking, L. B. S., Orsi, R., & Cobb, R. B. (2012). Effects of a teacher professional development program on the mathematics achievement of middle school students. *Journal for research in mathematics education*, *43*(2), 159–181.

National Center for Education Statistics. (2016). The condition of education 2016 (NCES 2016–144).

Polly, D., Wang, C., Petty, T., & Binns, I. (2022). Exploring the empirical connection between student, teacher, school, and district-level variables on fifth grade students' mathematics achievement. *School Science and Mathematics, 122*(3), 169–178.

Prestwich, P. J. (2015). *Mathematical interactions between teachers and students in the Finnish mathematics classroom*. Brigham Young University.

Saija, L. M. (2021). Analysis on students' mathematics achievement based on learning styles. *Journal Magister Pendidikan Matematika* (JUMADIKA), 3(2), 59-64.

Stevenson H. W. & Stigler J. W. (1992). *The learning gap: Why our schools are failing and what we can learn from Japanese and Chinese education*. Summit Books.

Stigler, J. W., & Hiebert, J. (1999). *The teaching gap: Best ideas from the world's teachers for improving in the classroom*. New York: The Free Press.

Strauss, A., & Corbin, J. (1994). Grounded theory methodology: An overview. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 273–285). Sage Publications, Inc.

Zhu, Z. (2007). Gender differences in mathematical problem-solving patterns: A review of literature. *International Education Journal*, *8*(2), 187–203.