

Preschool educators' pre-numerical skill pedagogical challenges

Julianty Idris, Norly Jamil, Arulmozhi Narayanasamy

Department of Early Childhood Education, Faculty of Human Development, Universiti Pendidikan Sultan Idris, Tanjung Malim, Malaysia

Article Info

Article history:

Received Sep 5, 2024

Revised Apr 20, 2025

Accepted Jul 17, 2025

Keywords:

Educator capability

Pedagogical challenges

Pre-numerical skill awareness

Pre-numerical skills

Preschool educators

ABSTRACT

The current study seeks to determine the challenges encountered by preschool educators' pre-numerical skill pedagogical challenges. A qualitative approach, namely interviews, was employed and conducted among six experienced preschool teachers to acquire in-depth insights into the challenges encountered in inculcating pre-numerical skills. The six respondents were recruited via purposive sampling, namely maximum variation sampling, to fulfil specific criteria. Four primary themes were revealed, namely i) Theme 1: teachers lack specific guidance due to the highly general Kurikulum Standard Prasekolah Kebangsaan (KSPK); ii) Theme 2: students from low socioeconomic backgrounds exhibit deficiencies in pre-numerical knowledge; iii) Theme 3: teachers demonstrate an insufficient competence in pre-numerical teaching pedagogies; and iv) Theme 4: an inadequate awareness among teachers regarding the importance of pre-numerical skills exists. The implications highlighted the requirement for tailored support and training to improve preschool teachers' pre-numerical skill pedagogies. The findings also contributed to the curricular improvement to assist preschool educators in providing more effective pedagogical practices, especially pre-numerical skills. Future scholars can conduct a more in-depth investigation of effective teaching strategies and interventions to aid students from low socioeconomic backgrounds in mastering pre-numerical competencies.

This is an open access article under the [CC BY-SA](#) license.



Corresponding Author:

Norly Jamil

Department of Early Childhood Education, Faculty of Human Development

Universiti Pendidikan Sultan Idris

Tanjung Malim, Perak, Malaysia

Email: norly@fpm.upsi.edu.my

1. INTRODUCTION

Rapid technological advancements in a highly globalised world necessitate early childhood education to develop a robust foundation for children's skills and knowledge. Specifically, pre-numerical skills, such as pattern recognition and construction, sequence creation, quantity comparisons, object matching, and consistency concept understanding, were underscored as one of the key childhood educational aspects in the Kurikulum Standard Prasekolah Kebangsaan (KSPK) [1]. A robust foundation of pre-numerical skills ensures comprehensive early mathematical development among young children, particularly during initial growth stages [2]. Decarli *et al.* [3] delineated that the competency to estimate numbers is pivotal to children's mastery of mathematics. Nevertheless, preschool educators experience multiple barriers in efficaciously inculcating pre-numerical skills as the general nature of the KSPK does not provide specific directions for preschool educators [4]. Roslin *et al.* [5] also elucidated the difficulties in implementing the national preschool curriculum owing to inadequate skills and knowledge, insufficient training, and limited experiences in early childhood education. Furthermore, students' low socioeconomic status aggravates the situation due to higher challenges in accessing educational manipulatives, materials, and supportive technological instruments [6]–[8].

Resultantly, young children receive lower exposure to vital mathematical concepts when the capability to perform meaningful mathematical activities is impeded, especially in home environments, which reduces the ability to practise pre-numerical skills in daily life [7], [8].

Scarce educational resources among preschool mathematic educators lead to lower instruction quality and rigour when relevant activities cannot be efficaciously developed due to insufficient technologies, materials, or professional developmental opportunities. Moreover, educational gaps may be further widened and exacerbate unequal accessibility to high-quality pre-numerical pedagogies [9]. Fischetti [10] demonstrated that numerous children did not master early mathematical skills owing to unsupportive pedagogies and scarce research on efficacious early mathematical pedagogies [11]. Lower awareness levels regarding the significance of pre-numerical skills among parents and preschool educators have also contributed to insufficient emphasis on pre-numerical skills compared to number concepts and operations [2], [4], [12]. In addition, Chirimbana *et al.* [6] analysed the barriers to effectively inculcating pre-numerical skills, such as socioeconomic variations, parental involvement, educator training support, language and cultural differences, and limited technological facilities support. A low understanding of pre-numerical skills among children could result in low mastery of fundamental arithmetic, including multiplication, subtraction, addition, and division [13], [14] and subsequently more difficulties in logical reasoning, such as quantity estimations or mental calculation, and more advanced mathematical concepts, including geometry, algebra, and statistics [15], [16].

Insufficient professional developmental opportunities hinder educators' capacities to develop and implement efficacious pre-numerical pedagogies. Particularly, certain preschool educators may not effectively implement the most optimal approaches to explicate and inculcate mathematical concepts and skills among young children [17]–[20]. Moreover, creative and innovative pedagogies may be neglected when preschool educators are not confident or comfortable and become confused, anxious, and hesitant owing to insufficient mathematical skills and knowledge [21]–[23]. Consequently, ineffective pedagogies may lead students to consider mathematics as a highly challenging subject. Preschool educators' early mathematical teaching and learning approaches, especially pre-numerical skills, should be appropriately developed to ensure children can more effortlessly master more challenging early mathematical skills. Pre-number skills are also integral to stimulating young children's cognitive development while improving logical thinking and problem-solving abilities for daily life. Summarily, preschool teachers' pre-numerical pedagogical challenges are intricate owing to the presence of multiple interacting factors, such as inadequate curricular knowledge and training, highly general curricular guidelines, and the students' underprivileged socioeconomic status. Targeted interventions should be developed to effectively resolve existing challenges in guaranteeing young children's equal accessibility to educational resources. Accordingly, the current study seeks to discover the specific factors contributing to preschool teachers' pre-numerical pedagogical challenges.

2. METHOD

Semi-structured interviews were conducted among six experienced preschool educators. The interview instrument for this study was rigorously validated by three experts, each with extensive backgrounds in early childhood education, qualitative research, and mathematics education. The experts were selected based on their qualifications and experience in areas directly related to early childhood education. This validation process aimed to ensure that the questions were clear, relevant, and aligned with the research objectives while ensuring that the language used was appropriate for the target respondents. The interviews motivated respondents to freely express personal opinions, perspectives, and ideas [24] while ensuring the researcher collected in-depth responses and fostered conversation management [25], [26]. The respondents were recruited through purposive sampling with maximum variation to fulfil specific criteria [27]. Specifically, respondents were recruited from distinct regions and educational institutions to holistically capture diverse experiences and perspectives. Additionally, the data collection and analysis procedures were performed by adhering to Creswell's [28] and Miles's and Huberman's [29] guidelines. All interviews were recorded and transcribed for thematic analysis to pinpoint patterns, recurring themes, and perspectives. Pertinent categorisation and coding were conducted before analysis, which allowed all respondents to ascertain a high accuracy level of the transcribed verbatim responses [26].

3. RESULTS AND DISCUSSION

The semi-structured interviews with the six respondents contributed valuable insights into the existing pre-numerical pedagogical challenges in preschools and discovered four primary themes.

3.1. Theme 1: insufficient specific guidance due to the highly general KSPK

Respondents 2, 5, and 6 with 15 years of preschool teaching experience expressed challenges in educating preschool pre-numerical skills owing to the inadequate specific guidance provided by the KSPK,

which could not sufficiently support preschool educators in developing efficacious instructional strategies to inculcate the concepts of patterns, seriation, and consistency:

“...There are not a clear guideline or basic facts about certain topics. For example, we teachers find it a bit difficult to find information. Even on YouTube or elsewhere, it’s hard to find. For instance, on the topic of consistency. Sometimes, as teachers, we actually lack a true understanding of consistency.” (R2-challenge-T1)

“...Lack of guidance, like in our KSPK, it just gives general information, right? So, even though we’re experienced teachers, it’s hard to convey the guidance from the KSPK itself, which is too brief. For example, in pre-numerical skills, when we talk about seriation and patterns, sometimes we also get confused about what exactly seriation is, what a pattern is, and the difference between seriation and patterns, right? Also, in the subtopic of consistency, we don’t know how to teach it. Some teachers don’t fully understand the concept of consistency, and if there were a guide, it would help teachers in the teaching process.” (R5-challenge -T1)

“...The challenge is the lack of clear guidance, especially in the consistency part, like mass and volume, which sometimes we confuse a bit with early science, right? And another challenge for me is teaching patterns. I have some difficulty getting the children to understand the concept of patterns.” (R6- challenge-T1)

The findings propounded that the highly general KSPK posed a significant challenge for preschool educators’ pre-numerical pedagogies owing to low clarity and lack of specific instances for the concepts of patterns, seriation, and consistency for students’ thorough understanding and mastery. The vagueness also led to higher uncertainty in selecting and implementing the most suitable instruction. Zucker *et al.* [30] also demonstrated that preschool educators did not thoroughly comprehend early childhood educational curricula due to inadequate materials supporting relevant curricular application to young children. Simultaneously, Murray [31] and Safi *et al.* [32] highlighted the requirement for an unambiguous and holistic curricular model to ensure efficacious pedagogy and student learning as general standards would result in higher confusion and inconsistent instruction with adverse impacts on students’ academic progress. Rege *et al.* [33] also uncovered that detailed curricular standards and specific instructional support assisted educators in grasping complex concepts through solid instances and classroom instructional approaches to cultivating young children’s foundations, especially mathematics. Summarily, revising and refining the existing KSPK are imperative to provide practical examples, specific standards, and clear elaborations of crucial mathematical concepts, which can prepare educators with efficacious pedagogical practices while improving preschool children’s learning experiences and outcomes.

3.2. Theme 2: inadequate pre-numerical knowledge among students with low socioeconomic status

The interview findings demonstrated socioeconomic status presented a significant barrier to preschool educators when students with low socioeconomic status frequently struggled to master pre-numerical skills, according to respondent 1. The students generally have not received any prior education before entering preschool and do not possess existing mathematical knowledge and exposure at home:

“...Okay, the challenge is, umm, the existing knowledge that the students have usually comes from their families. Typically, suppose students do not understand at all. In that case, they have never attended any other school or been exposed to pre-numerical learning at home due to their low socioeconomic background. So, my challenge is to make the students who do not understand, understand. These students have varying levels of intelligence. Those who already understand, the smart ones, immediately grasp the concept because they have existing knowledge. They can actively engage in activities. They find it easy to do things because they have had exposure at home. However, the weaker students, usually from low socioeconomic backgrounds, generally know nothing.” (R1-socioeconomic-T2)

Respondent 4 consented that low socioeconomic status posed a significant challenge in teaching pre-numerical skills in preschool. The experience of teaching in rural areas for several years revealed that students from less affluent backgrounds generally encountered sluggish mathematical development due to the inconducive environment and insufficient existing knowledge. For instance, the students could not match spoons and forks or socks and shoes as the utensils were not employed at home and only shoes without socks were worn to school.

“...One of the challenges I can remember in teaching pre-numerical skills... specifically... umm, is the students’ existing knowledge. Their existing knowledge is, for example, like I said earlier, related to their environment. For instance, when we talk about spoons and forks, some students do not have spoons and forks at home or only spoons. At home, they eat with their hands. So, they do not know what a fork is when we want to do matching activities. For example, socks and shoes. Some students from less affluent backgrounds, whose families are struggling, only wear shoes. They do not wear socks. So, do we wear socks when we want to do matching activities? They might have never seen socks before. This is based on my experience teaching in rural areas. So, they do not know. That is one of the challenges related to the student’s background.” (R4-socioeconomic-T2)

The current results corresponded to prior scholars discovering the ubiquitous trend of limited accessibility to early educational resources among students from lower socioeconomic status, which negatively impacted pre-numerical skill development. Lombardi and Dearing [34] revealed that the lack of access to educational toys, reading materials, and a conducive home environment with multiple learning activities rendered fewer opportunities to develop pre-numerical skills among students from lower socioeconomic status, which generated a knowledge gap before entering preschool institutions. Liang *et al.* [35] also demonstrated that a home environment without sufficient educational resources, including educational toys and books, adversely influenced young children’s cognitive development and remained sluggish in developing critical learning domains, especially pre-numerical skills. Hence, preschool educators are frequently required to adapt existing pedagogical approaches to fulfil the specific requirements of children from low socioeconomic status when early exposure to fundamental pre-numerical concepts is limited.

Inadequate early exposure impedes young students’ abilities to thoroughly understand the preschool curriculum while additional interventions are also necessitated to maintain the same learning pace as peers at higher socioeconomic status. Moreover, preschool educators without sufficient support in terms of supplemental materials or targeted strategies would encounter higher challenges in fulfilling diverse student requirements, particularly different socioeconomic status. Lombardi and Dearing [34] emphasised the importance of additional educational materials and intervention programmes for students with low socioeconomic status to resolve the current challenge. Specifically, a holistic intervention programme can enrich pre-numerical learning experiences via pertinent educational materials and practical activities. Supporting preschool educators’ professional development and technological integration in the classroom can also equip educators with more efficacious pedagogical approaches while empowering young students with low socioeconomic status to employ digital tools to grasp pre-numerical concepts and master relevant skills.

3.3. Theme 3: preschool educators’ inadequate teaching capabilities

The theme emerged from the interviews with respondents 3 and 4, who explicated the challenges encountered by educators in effectively conveying pre-numerical concepts to students for swift understanding as existing approaches might not be appropriate for students’ different developmental phases:

“...In terms of factors as a teacher, one of the challenges is how we explain things to the students. As teachers, we have trouble figuring out how to convey the concepts so the students can understand. Umm, so maybe... the techniques I use are unsuitable for students at different developmental stages. We need to think of a way to make the teaching appropriate for all levels of students. Teachers must be creative by diversifying their teaching strategies to match students with varying developmental stages.” (R4-strategy-T3)

Respondent 3 acknowledged the requirement to improve existing pedagogical methods to fulfil students’ diverse needs:

“...Teaching strategies need to be improved too. Maybe I need to improve how I deliver the lessons to the students. Yes, I think we need a study like this to understand how we, as teachers, can teach mathematics correctly.” (R3-strategy-T3)

The interview findings demonstrated limited pedagogical abilities posed a significant challenge to preschool educators to efficaciously explicating pre-numerical concepts to students at different developmental phases. Thus, educators should enhance personal creativity and flexibility by implementing diverse pedagogical approaches to assist students at diverse developmental phases could thoroughly comprehend and effectively master pre-numerical skills. Jihan *et al.* [36] also indicated that pedagogical capabilities significantly impacted students’ learning outcomes. Efficacious educator training and pedagogical methods allowed educators to continuously adapt existing approaches to fulfil diverse learning requirements for higher pedagogical and learning effectiveness. Conversely, insufficient capabilities would lead preschool students not

to thoroughly understand the pre-numerical concept. König *et al.* [37] also discovered that specific teaching knowledge played a vital role in effectively delivering mathematical concepts. Robust educator training in specific subjects and domains can equip educators with pertinent pedagogical knowledge and practices. Concurrently, the current study revealed that limited training resulted in preschool educators highly depending on conventional pedagogical approaches, which could not effectively fulfil diverse learning requirements contemporarily. Egert *et al.* [38] revealed that continuous preschool educator training programmes concentrating on specific pedagogical practices could aid educators in resolving encountered challenges while enhancing learning outcomes. Resultantly, preschool educators can formulate and apply more effective pedagogical approaches to guarantee students from diverse socioeconomic backgrounds with varying developmental phases could enjoy the benefits of high-quality instruction.

3.4. Theme 4: low pre-numerical skill awareness levels

The findings demonstrated that preschool educators were frequently unaware of the significance of pre-numerical skills, which led to lower emphasis on relevant skills among students. Respondent 6 elaborated that the lack of attention was partially owing to parents who prioritised children's mastery of addition, numbers, and subtraction over the fundamental pre-numerical skills, which could prevent reinforcing the essential pre-numerical skills integral to children's early cognitive development:

“...Parent demand also plays a role, yes. And as a teacher, sometimes I am not fully aware of it. This is a basic skill that we should reinforce further in the children.” (R6-awareness-T4)

Respondents 3 and 5 acknowledged that preschool educators frequently neglected pre-numerical skills owing to the higher emphasis on addition, number concepts, and subtraction, which were considered more crucial. The absence of specific guidelines also contributed to the lower attention towards pre-numerical skills:

“...We emphasise the number concept and numerical operations so much that we forget and overlook the importance of pre-numerical experiences for children. Then, pre-numerical skills are even more neglected. And again, we don't have a guide; the available guidance is too general, so we skip topics and skip the specific subtopics. It feels somewhat frustrating sometimes.” (R5-awareness-T4)

“...Sometimes, we also skip around, skip here and there... because we are rushing to cover number operations too. Sometimes, when we want to do it, there are so many things to cover that we rush and become disorganized.” (R3-awareness-T4)

Respondent 5 delineated that the lack of emphasis on educating pre-numerical concepts was due to the mindset that learners should excel in addition, subtraction, and number concepts before focusing on other topics:

“...The issue is that we need to emphasise that children must be proficient in addition, subtraction, and number concepts. This is the mindset of the teachers. So, they overlook the basic skills that students should first master, pre-numerical skills.” (R5-awareness-T4)

Respondent 3 highlighted that pre-numerical skills were frequently neglected by preschool educators owing to the absence of specific curricular standards. Respondent 5 also underscored that preschool educators who perceived mastering addition and subtraction operations was more crucial compared to pre-numerical skills. The tendency indicated that preschool educators did not thoroughly comprehend the significance of pre-numerical skills in early mathematical development by omitting pre-numerical topics that were perceived to be less pivotal. Resultantly, mathematical instruction became unsystematic. The present study highlighted the vital function of pre-numerical concepts and skills in cultivating young learners' logical thinking and problem-solving capabilities in quotidian lives by performing abstract thinking to resolve practical challenges, including shoe-wearing or object arrangement in a specific sequence [39].

Khani *et al.* [40] also discovered that efficacious pre-numerical pedagogy improved young learners' logical thinking and problem-solving skills for daily life. Therefore, preschool educators should be intensively trained to be equipped with efficacious instructional strategies. Specific curricular standards, training programmes, and workshops play a crucial role in increasing pre-numerical skill awareness among parents, educators, and caregivers. Constant educational support and holistic training can also equip educators with adequate mathematical knowledge and skills to deliver pre-numerical concepts clearly and concisely [41]. Training programmes should prioritise practical pedagogical approaches that are highly applicable to classroom instruction while ensuring sufficient adaptability to fulfil diverse learner requirements.

4. CONCLUSION

The current study appraised preschool educators encountered pre-numerical pedagogical challenges by conducting semi-structured interviews with six respondents. The interview findings were thematically analysed, which discovered four primary themes, namely the general KSPK without specific guidelines, limited pre-numerical knowledge among students with low socioeconomic status, low pre-numerical pedagogical capabilities, and limited awareness regarding the significance of pre-numerical skills. This study makes a novel contribution to the field of early mathematics education by providing an in-depth exploration of the challenges faced by preschool teachers in teaching pre-number skills an aspect that has received limited attention in previous research. Unlike other studies that primarily focus on mathematics instruction in general, this research highlights how curriculum factors, teacher competency levels, and students' socioeconomic backgrounds influence the learning of pre-number skills. The uniqueness of this study also lies in its identification of four key challenges, particularly the lack of specific guidance within the KSPK and the low level of awareness among teachers regarding the importance of pre-number skills. By employing maximum variation sampling, this study captures diverse perspectives from experienced preschool teachers, offering a more comprehensive understanding of the challenges encountered in teaching pre-number skills.

The findings posited the requirement for more educator training, specific curricular standards, and higher awareness of the significance of pre-numerical skills to enhance preschool classroom instruction. Theoretically, a highly general curricular standard would engender higher student confusion and inconsistent pedagogical approaches, which hindered the thorough understanding of pre-numerical concepts. Young students' socioeconomic status also played a significant role in the mastery of pre-numerical skills. In addition, a qualitative methodology, namely semi-structured interviews, enriched the existing empirical evidence. Meanwhile, future scholars can consider incorporating quantitative techniques to acquire more comprehensive data that represent a larger population. Longitudinal research can also be conducted to determine the long-term impacts of tailored interventions to enhance preschool educators' pedagogical practices. Simultaneously, examining the efficacies of educator training programmes can assist in discovering the most effective pre-numerical pedagogical methods, especially for learners with low socioeconomic status, to ensure a higher quality of preschool pre-numerical and develop a robust mathematical foundation in children's early developmental phases.

ACKNOWLEDGMENTS

We would like to express our appreciation to all participants for their invaluable support and cooperation, which were essential to the successful completion of this study.

FUNDING INFORMATION

Authors state no funding involved.

AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Julianty Idris	✓	✓		✓	✓			✓	✓	✓	✓			
Norly Jamil	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓		
Arulmozhi		✓		✓					✓	✓		✓		
Narayanasamy														

C : Conceptualization

I : Investigation

Vi : Visualization

M : Methodology

R : Resources

Su : Supervision

So : Software

D : Data Curation

P : Project administration

Va : Validation

O : Writing - Original Draft

Fu : Funding acquisition

Fo : Formal analysis

E : Writing - Review & Editing

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

Data availability is not applicable to this paper as it is based on qualitative research.

REFERENCES

- [1] Malaysian Ministry of Education, "National Preschool Standard Curriculum (KSPK)," (in Malay), Curriculum Development Division, 2017.
- [2] P. Flores, E. Coelho, M. I. Mourão-Carvalhal, and P. Forte, "Motor activities to improve maths performance in pre-school children with typical development," *Frontiers in Psychology*, vol. 15, 2024, doi: 10.3389/fpsyg.2024.1332741.
- [3] G. Decarli, D. Zingaro, L. Surian, and M. Piazza, "Number sense at 12 months predicts 4-year-olds' maths skills," *Developmental Science*, vol. 26, no. 6, 2023, doi: 10.1111/desc.13386.
- [4] R. Chavira-Quintero and J. M. Olais-Govea, "Analysis of content knowledge categories in preservice teachers when teaching the concept of number in preschool," *Sustainability (Switzerland)*, vol. 15, no. 5, 2023, doi: 10.3390/su15053981.
- [5] R. Roslin, K. Abu Bakar, and M. A. Madar, "Teacher competence in the implementation of national preschool curriculum," *International Journal of Academic Research in Progressive Education and Development*, vol. 12, no. 1, 2023, doi: 10.6007/ijarped/v12-i1/16387.
- [6] M. Chirimbana, B. Makaka, and L. Hilongwa, "Understanding the factors and challenges in developing number sense in early childhood education: a case study of the Oluno Circuit," *Open Journal of Social Sciences*, vol. 12, no. 02, pp. 168–188, 2024, doi: 10.4236/jss.2024.122011.
- [7] P. Starkey, A. Klein, B. Clarke, S. Baker, and J. Thomas, "Effects of early mathematics intervention for low-SES pre-kindergarten and kindergarten students: a replication study," *Educational Research and Evaluation*, vol. 27, no. 1–2, pp. 61–82, 2022, doi: 10.1080/13803611.2021.2022316.
- [8] F. Sepúlveda, C. Rodríguez, and C. Peake, "Differences and associations in symbolic and non-symbolic early numeracy competencies of chilean kinder grade children, considering socioeconomic status of schools," *Early Education and Development*, vol. 31, no. 1, pp. 137–151, 2020, doi: 10.1080/10409289.2019.1609819.
- [9] S. Goudeau *et al.*, "Unequal opportunities from the start: socioeconomic disparities in classroom participation in preschool," *Journal of Experimental Psychology: General*, vol. 152, no. 11, pp. 3135–3152, 2023, doi: 10.1037/xge0001437.
- [10] J. C. Fischetti, "Issues in education: last stand for teacher education," *Childhood Education*, vol. 89, no. 1, pp. 40–41, Jan. 2013, doi: 10.1080/00094056.2013.757523.
- [11] B.-S. Ilany and M. Ben-Yehuda, "Developing mathematics teaching in kindergarten," *Creative Education*, vol. 12, no. 02, pp. 369–377, 2021, doi: 10.4236/ce.2021.122026.
- [12] E. S. Levenson, R. Barkai, D. Tirosh, and P. Tsamir, "Exploring adults' awareness of and suggestions for early childhood numerical activities," *Educational Studies in Mathematics*, vol. 109, no. 1, pp. 5–21, 2022, doi: 10.1007/s10649-021-10063-y.
- [13] E. Szkudlarek, H. Zhang, N. K. DeWind, and E. M. Brannon, "Young children intuitively divide before they recognize the division symbol," *Frontiers in Human Neuroscience*, vol. 16, 2022, doi: 10.3389/fnhum.2022.752190.
- [14] S. A. Malone, K. Burgoyne, and C. Hulme, "Number knowledge and the approximate number system are two critical foundations for early arithmetic development," *Journal of Educational Psychology*, vol. 112, no. 6, pp. 1167–1182, 2020, doi: 10.1037/edu0000426.
- [15] J. Kilpatrick, J. Swafford, and B. Findell, *Adding it up: Helping children learn mathematics*. Washington, D.C.: National Academies Press, 2001, doi: 10.17226/9822.
- [16] H. Lindström-Sandahl, J. Samuelsson, H. Danielsson, S. Samuelsson, and Å. Elwér, "A randomized controlled study of a second grade numeracy intervention with Swedish students at-risk of mathematics difficulties," *British Journal of Educational Psychology*, vol. 94, no. 4, pp. 1052–1071, 2024, doi: 10.1111/bjep.12705.
- [17] X. Li, "Investigating U.S. preschool teachers' math teaching knowledge in counting and numbers," *Early Education and Development*, vol. 32, no. 4, pp. 589–607, 2020, doi: 10.1080/10409289.2020.1785226.
- [18] H. M. Costa, L. A. Outhwaite, and J. Van Herwegen, "Preschool teachers' training, beliefs and practices concerning mathematics in pre-schools in the UK: implication for education and practice," pp. 1–29, Feb. 23, 2021, doi: 10.31234/osf.io/rdx6c.
- [19] D. H. Clements, R. Lizcano, and J. Sarama, "Research and pedagogies for early math," *Education Sciences*, vol. 13, no. 8, 2023, doi: 10.3390/educsci13080839.
- [20] N. Gqoli, C. Okeke, and C. Ugwuanyi, "Practitioners' challenges in the application of conceptions of mathematical knowledge in the foundation phase mathematics learning," *International Journal of Research in Business and Social Science (2147-4478)*, vol. 11, no. 8, pp. 360–366, 2022, doi: 10.20525/ijrbs.v1i18.2053.
- [21] G. Jelovčan and T. Volmut, "Presenting the selection of innovative approaches taken in physical activities in the pre-school period," *Inovacije u nastavi*, vol. 35, no. 2, pp. 145–154, 2022, doi: 10.5937/inovacije2202145J.
- [22] L. Jenßen, G. Hosoya, A. Jegodtka, K. Eilerts, M. Eid, and S. Blömeke, "Effects of early childhood teachers' mathematics anxiety on the development of childrens' mathematical competencies," *Student Learning in German Higher Education: Innovative Measurement Approaches and Research Results*, pp. 141–162, 2020, doi: 10.1007/978-3-658-27886-1_8.
- [23] J. Park, G. Ramirez, and D. Park, "Effect of preschool teacher's math anxiety on teaching efficacy and classroom engagement in math," *Psychology in the Schools*, vol. 61, no. 6, pp. 2600–2611, 2024, doi: 10.1002/pits.23182.
- [24] X. Shen, G. Barlauchi, M. del Tredici, W. Cheng, and A. de Gispert, "semiPQA: a study on product question answering over semi-structured data," in *ECNLP 2022 - 5th Workshop on e-Commerce and NLP, Proceedings of the Workshop*, 2022, pp. 111–120, doi: 10.18653/v1/2022.ecnlp-1.14.
- [25] J. W. Creswell and J. D. Creswell, *Research design: qualitative, quantitative, and mixed methods approaches*. 4th ed., Newbury Park: SAGE, 2017.
- [26] L. Cohen, L. Manion, and K. Morrison, *Research methods in education*. London: Routledge, 2002, doi: 10.4324/9780203224342.
- [27] F. Nyimbili and L. Nyimbili, "Types of purposive sampling techniques with their examples and application in qualitative research studies," *British Journal of Multidisciplinary and Advanced Studies*, vol. 5, no. 1, pp. 90–99, 2024, doi: 10.37745/bjmas.2022.0419.
- [28] J. W. Creswell, "Editorial: mapping the field of mixed methods research," *Journal of Mixed Methods Research*, vol. 3, no. 2, pp. 95–108, Apr. 2009, doi: 10.1177/1558689808330883.
- [29] M. B. Miles and A. M. Huberman, *Qualitative data analysis: an expanded sourcebook*. Thousand Oaks: SAGE, 1994.

[30] T. A. Zucker, E. Jacobos, and S. Q. Cabell, "Exploring barriers to early childhood teachers' implementation of a supplemental academic language curriculum," *Early Education and Development*, vol. 32, no. 8, pp. 1194–1219, 2021, doi: 10.1080/10409289.2020.1839288.

[31] J. Murray, "Young children's curriculum experiences," *International Journal of Early Years Education*, vol. 30, no. 4, pp. 627–633, Oct. 2022, doi: 10.1080/09669760.2022.2149092.

[32] A. B. Safi, S. Z. U. R. Banouri, and H. Atifnigar, "Exploring children's developmental stages and preparation of a framework for comprehensive and creative curriculum," *European Journal of Theoretical and Applied Sciences*, vol. 1, no. 5, pp. 1025–1032, 2023, doi: 10.59324/ejtas.2023.1(5).89.

[33] M. Rege *et al.*, "The effects of a structured curriculum on preschool effectiveness: a field experiment," *Journal of Human Resources*, vol. 59, no. 2, pp. 576–603, 2024, doi: 10.3388/jhr.0220-10749R3.

[34] C. M. Lombardi and E. Dearing, "Maternal support of children's math learning in associations between family income and math school readiness," *Child Development*, vol. 92, no. 1, pp. e39–e55, 2021, doi: 10.1111/cdev.13436.

[35] Y. Liang, H. Cao, N. Zhou, J. Li, and L. Zhang, "Early home learning environment predicts early adolescents' adjustment through cognitive abilities in middle childhood," *Journal of Family Psychology*, vol. 34, no. 8, pp. 905–917, 2020, doi: 10.1037/fam0000675.

[36] Jihan, A. Nurfadillah, and T. H. Daulay, "Teacher competence in improving student achievement," *LECTURES: Journal of Islamic and Education Studies*, vol. 2, no. 3, pp. 118–126, 2023, doi: 10.58355/lectures.v2i3.33.

[37] J. König *et al.*, "The links between pedagogical competence, instructional quality, and mathematics achievement in the lower secondary classroom," *Educational Studies in Mathematics*, vol. 107, no. 1, pp. 189–212, 2021, doi: 10.1007/s10649-020-10021-0.

[38] F. Egert, V. Dederer, and R. G. Fukkink, "The impact of in-service professional development on the quality of teacher-child interactions in early education and care: a meta-analysis," *Educational Research Review*, vol. 29, 2020, doi: 10.1016/j.edurev.2019.100309.

[39] D. H. Clements, J. Sarama, C. Layzer, and F. Unlu, "Implementation of a scale-up model in early childhood: long-term impacts on mathematics achievement," *Journal for Research in Mathematics Education*, vol. 54, no. 1, pp. 64–88, 2023, doi: 10.5951/jresmatheduc-2020-0245.

[40] R. Khan, M. B. Pour, and A. Abedi, "The effectiveness of training the successful intelligence on problem solving skills in preschool children," *Iranian Journal of Pediatric Nursing*, vol. 6, no. 3, pp. 45–52, 2021.

[41] L. Derman-Sparks and J. O. Edwards, *Anti-bias education for young children and ourselves*. Washington, DC: National Association for the Education of Young Children, 2010.

BIOGRAPHIES OF AUTHORS



Julianty Idris     is currently a student funded by the Ministry of Education Malaysia under the KPM-full-time federal training grant (PhD). She is pursuing her PhD with full sponsorship from the Ministry of Education Malaysia's Sponsorship Division. Her research interest involves on early childhood education and children's pre-number concept. She can be contacted at email: jueidris3742@gmail.com or jueidris8112@gmail.com.



Norly Jamil     is a senior lecturer at the Department of Early Childhood Education, Faculty of Human Development, Universiti Pendidikan Sultan Idris. She specializes in early childhood education, early mathematics education, qualitative approach, and pre coding. She can be contacted at email: norly@fpm.upsi.edu.my.



Arulmozhi Narayanasamy     is currently a student funded by the Ministry of Education Malaysia under the KPM-full-time federal training grant (PhD). She is pursuing her PhD with full sponsorship from the Ministry of Education Malaysia's Sponsorship Division. Her research interest involves on early childhood education and Malay language. She can be contacted at email: arulragu17@gmail.com.