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A Systematic Review of the Challenges in Teaching Programming for Primary Schools' Students

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Abstract: Programming and coding in primary education become solicitude globally today. Governments all over the world agreed on the importance of education towards workforce empowerment in the future for the country's development. As primary education is the foundation to produce future human resources, the government decided to make curricular changes starting with young learners. The schooling system tries to adapt to the rapid changes caused by The Industrial Revolution 4.0 by introducing programming education at an early stage. The increased usage of automation, robots, and artificial intelligence in the industry nowadays makes people aware of the importance of mastering programming and coding skill to survive in their future careers. Through the learning process of programming and coding, young students start to be exposed to computational skill which involves critical thinking and imagining creatively. Programming and coding education promote computational thinking for young learners which includes problem-solving skills like deconstruction, abstraction, pattern recognition, and algorithms. This paper examines research exploring the challenges faced by teachers, students, facilities, parents, and the government in the implementation of programming education in primary schools. The exploration was done through a systematic literature review of 20 articles published between the years 2018 and 2022. The selection of 20 articles required is based on the PRISMA guidelines to select papers. The findings provide insight into what has and has not been studied across a range of literature and the alignment with the broader context of programming education at the primary level. From this study, it can be identified that teachers' competency, teachers' digital pedagogy, students' readiness, school facilities, parents' support, and government educational planning play a very important role to make programming education for young learners successful.

Keywords: Programming in primary school, computational thinking, competency, problem solving, coding, programming challenges

1. Introduction

A few years back, programming and coding become the main concern in primary education as the world is moving forward into Industrial Revolution 4.0. The Industrial Revolution 4.0 was established in 2016, beginning with developed and high-tech industrial nations like Germany and the United States before spreading to Asian nations like China, South Korea, Singapore, and Malaysia (Lai & Aziz, 2019). The arrival of the Industrial Revolution 4.0 has significantly altered people's working habit (Abdelmajied, 2022). Industry 4.0 has the potential to attract people into smarter networks, which could result in more productive working. Digitization in the manufacturing environment offers more flexible ways to deliver the right information to the right person at the right time. Current phenomena in the industrial field that changing is that many companies start to reduce human labor for routine work and replace it with

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robots and automation systems. Consequently, the need for talent in the labor market is changing as a result of the increased usage of automation, robots, and artificial intelligence; some old occupations are disappearing while others are being developed (Predrag, 2021).

The rapid changing of economic and industrial growth in global level at the same time affecting the landscape of education globally. In recent years, growing attention has been given to integrating programming education in elementary school (Allsop, 2019). The Industrial Revolution 4.0 which involves rapid progress in the fields of robot automation, artificial intelligence, big data, and numerous other new technological developments, is currently posing a challenge to national education (Badrulhisham *et al.*, 2019). We will not be able to face the Industrial Revolution 4.0 challenges if we still depend on the old education. Stick to the outdated education will only make Malaysia fall far behind like third countries. Education should be in line with the development of the industry to provide a balance between education and the industry workforce demand. Unbalanced supply and demand of the human workforce because of skill needed mismatch can cause unemployment issue.

Education is the main pillar of workforce empowerment in the future for the development of a country. The primary school students of today will be our future workforce, which will determine whether or not the country's long-term growth is successful. According to Abdul Khalil *et al*. (2020), education is the most crucial tool in the development of the human resources that will help the nation grow in the future. This statement is supported by Ahmad (2018) that every country in the world views education as fundamental to a nation's growth. As digitalization emerge in education, primary school students today can be better equipped for the workforce of the future by exposing them to the technologies they will probably use at work early in their education. Therefore, programming and coding is increasingly introduced at elementary schools around the world. According to Mannova (2022), The UK established coding as part of the curriculum in 2014 and England became the first country in the world to mandate teaching coding to children at primary and secondary schools. Computer programming became a compulsory topic in primary education in countries such as Finland, England, Estonia, Sweden, New South Wales in Australia, Japan, United Kingdom, Slovakia, Poland, France, and Croatia (Predrag, 2021).

Digital literacy like programming and coding is important to be taught at early stage of education. Through the learning process of programming and coding, young learners start to be exposed to the computational skill which involve critical thinking, imagine creatively, and problem-solving skill. According to Predrag (2021) computational thinking is a skill that may be developed through the study of computer programming in basic school since it allows pupils to practice problem-solving methods like deconstruction, abstraction, pattern recognition, and algorithms. Students can learn the fundamental concepts of computation and information through programming, as well as how digital systems operate and how to apply this knowledge to become digitally literate at early stage. Computation thinking managed to enhance one's capacity for higher order thinking skills and improve problem-solving skills (Ling *et al.*, 2018). The "4C" competency, which stands for "Critical thinking and problem solving, Communication, Collaboration, and Creativity and invention," is one that young children can learn through programming and coding and it may help them develop the computational thinking skill required to deal with challenges in the 21st century.

As programming and coding are important skills and competencies needed in the 21st century, robotics programming has been introduced in the Malaysian education system (Muhamad Yusof *et al.*, 2021). According to Maszlee Malik (2019) in an excerpt from the Astro Awani newspaper, the Malaysian Ministry of Education (MoE) has implemented coding-related learning for primary and secondary school students since 2016. MoE has introduced coding to primary school students through the Standard Primary School Curriculum (KSSR) while for secondary schools through the Standard Secondary School Curriculum (KSSM). The effort to introduce this coding has started in stages where in 2016, it was introduced to Year 6 students through Information and Communication Technology (TMK) subjects. Under KSSR Revision 2017, starting in 2020 Level 2 students (Year 4, Year 5 and Year 6) will learn coding in the new subject of Design and Technology (RBT). However, is Malaysia ready for it?

According to the Ministry of Education (MOE), the number of students enrolling in Science, Technology, Engineering, and Mathematics (STEM) courses is declining every year. Programming education is one of the STEM fields of study. Each year, there is an average reduction of about 6,000 students enrolling STEM (Muhamad Yusof et al., 2021). This situation will probably make it more difficult for the nation's planning to compete in the digital economy era in the upcoming era (Mohamad Marzuki et al., 2019). A report by the Ministry of Education in 2020 showed that only 47.18 percent of upper secondary level students across the country chose STEM fields of study. In fact, the Ministry of Education aims for 60% of students to take STEM courses. Based on the report of "Malaysia Education Blueprint 2013-2025", Malaysia is required to make stronger the STEM education to become a fully developed country that faces challenges and demands of a STEM-driven economy by 2025. While the role of STEM is closely related to emerging new jobs and the rapidly growing digital industry, the shortage of talent in the field has raised concerns.

The main focus in implementing these new curricular changes in Malaysian education are the level of readiness among all the involved stakeholders which are the Ministry of Education, teachers, students, parents, and facilities provided. Digitalization of education must be effectively regulated by all stakeholders, especially educational policymakers, as it will create new challenges for both teachers and students. Ling *et al.* (2018) stated that the teaching

and learning of programming skills are still given less attention due to challenges, such as teachers' lack of knowledge and skill.

The purpose of this systematic literature review is to:

a) Identify who will face the challenges and difficulties in implementing programming education in primary school.
b) Recognize what are the factors that contribute to the challenges of implementing programming in primary school.
c) Understand the relationship between computational thinking skill and programming.

2. Methodology

Systematic Literature Review (SLR) approach was used in this study to collect all related publications and documents that fit the pre-defined inclusion criteria to answer the specific research question. It uses unambiguous and systematic procedures to minimize the occurrence of bias during searching, identification, appraisal, synthesis, analysis, and summary of studies. A systematic approach plays an important role in various study circumstances. SLR can provide a summary of the state of knowledge in any field needed. For this study, SLR approach was applied to locate articles reporting research about programming in primary school. The articles were derived from few databases such as Google Scholar, Science Direct, and Eric. In a systematic review, the use of several databases will produce accurate results and retrieved more articles compared to using one database to summarize the results of various fields of related research studies.

The keywords used were "Programming for elementary school", "Programming and coding in primary school" and "Programming and computational thinking". While searching for the related articles, the limitation of the articles' published year has been set up. Only articles that published on year 2018 to 2022 are included. The total number of articles retrieved from all the databases is 8094. The search result shows the large number of items derived. However, only 20 articles have been chosen for this article review paper. Therefore, all the articles that are not relevant to the research questions and goals will be excluded. Table 1 show the distribution of the articles derived from 3 databases.

Table 1 - Total of article derived from each database

Keywords	Google Scholar	Science Direct	Eric
"Programming for elementary school"	65	87	2025
"Programming and coding in primary school"	111	73	4534
"Programming and computational thinking"	1140	54	5

The selection of 20 articles needed which related to this research study is based on the PRISMA (*Preffered Reporting Items for Systematic Reviews and Meta-Analysis*) guidelines to select papers by Moher *et al.,* 2009; updated 2020. PRISMA Flowchart for the Systematic Literature Review for this study as shown in Figure 1.

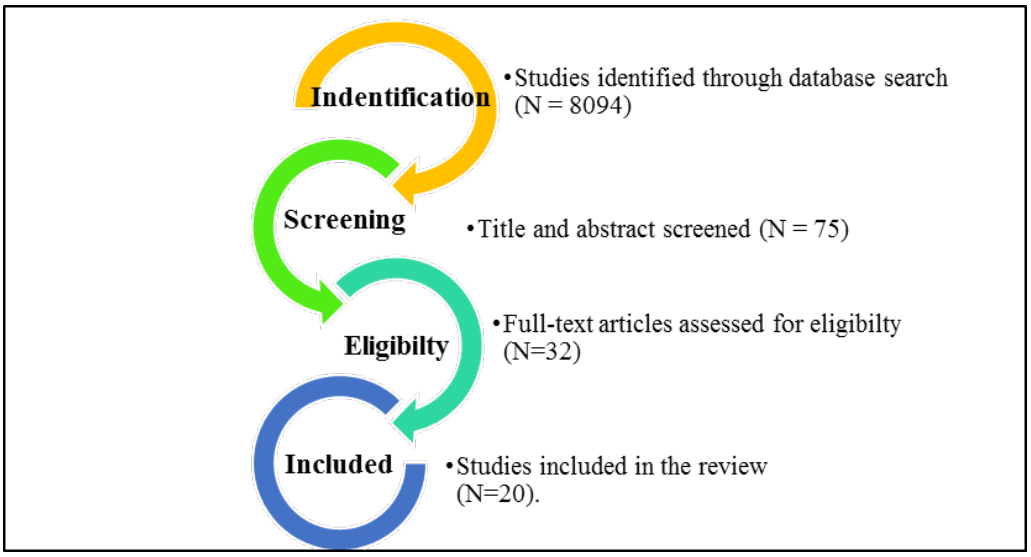

Fig. 1 - PRISMA flowchart

According to the PRISMA guideline to select papers, there are four steps to be accomplished before deciding the final articles that will be review in the study area. The four steps are identification, screening, eligibility and inclusion. For the first step which is identification step, the articles were retrieved from few databases involved Google Scholar, Science Direct, and Eric using the keywords which has been set; "Programming for elementary school", "Programming in primary school" and "Programming and computational thinking". All the keywords were decided to be used in order to fulfil the aim of this study and to answer all the research questions. The timeline also has been set up. Only articles from 2018 onwards will be included. To ensure that the source is as recent as possible, it is recommended that a reference be no more than five years old.

From all the 3 databases used, the total articles gain were 8094 articles. It is a huge amount as we only aim for 20 articles to be reviewed. So that we move to the second step which is screening all the articles retrieved in step 1. The screening process was done by looking at the tittle and abstract of the journal. The process was done manually in fast way to make sure it not takes a long time to decide. At this second step, only 75 articles left after duplicates removed and excluded unrelated studies. Next, the third step applied; the eligibility step. In this step, full-text articles assessed for eligibility has been done. It takes few days to read through all the articles before deciding only 32 articles included. The final step which is the included step is to reduce to bare bones. At the final step, only 20 articles left. The rest are excluded because few of the articles retrieved was proceeding paper and pilot study.

After choosing the desired articles, the next step is to produce an article matrix. The purpose of making the matrix is to get an overview of all identified studies. Through the matrix we can identify many important point from each articles in a simple and compact form such as the study's aim, the methods and the results of the study. This process will take a quite long time as we need to read all the 20 articles in details and put all the necessary data in the matrix. However, all the data will help us in our study about the programming in primary school. It will make easier for us in the discussion step as we already understand the study area in depth. By completing the matrix, we can identify the theme that related to our study area. From Table 2, we can see clearly which articles from 20 articles chosen are discuss about the same theme or same interest area. The repetition of the issue discussed in the studies will guide us to decide the issues and challenges to implement programming education in primary school level. The issues that can be identified from 20 articles chosen are teachers' competency in programming, students' readiness, computational thinking skill, parental concern and support, school facilities and government.

Through this SLR, we can fulfill the objectives of this study. First, we can identify that many stakeholders will face challenges in the implementation of programming education in primary schools which includes teachers, students, parents and the policy maker; Ministry of Education. Other than that, we also can meet the second objectives of this study which are recognizing the factors that contribute to the challenges of implementing programming in primary school. The factors are the competency in programming among the teachers, the level of students' readiness to learn programming in young age, to build the computational thinking skill among young child trough programming education, parents' anxiety towards programming education in primary school, school facilities that do not support programming learning and government planning, financial support, teaching material support, proper training for teachers. In addition, through this SLR study, we also can understand the relationship between computational thinking skill and programming clearly.

This literature review revealed that relatively little research has been done on programming education at an early age. The majority of current research efforts have primarily focused on the programming education in the contexts of secondary education and higher education in Malaysia. Thus, this literature review included all the existed research on programming education at an early age from all around the world. The results of all the studies about programming education in primary schools from around the world will be used to associate the differences within Malaysian context.

3. Findings and Discussion

Table 2 - Issues and challenges in programming education for primary school level

No	First Author & Title of Article	Country	Issues and Challenges								
			Teachers' Competency				Students' readiness	Computational thinking skill	Parents concern and support	Facility	Government
			Teachers' Knowledge	Teachers' Skill	Teachers' attitude	Digital Pedagogy					
1	Binaoui, A. (2022). The Effectiveness and Impact of Teaching Coding through Scratch on Moroccan Pupils' Competencies.	Morocco	√	√	√	√	√	√		√	√
2	Seda, A. (2022). Primary School Teachers' and Students' Views about Robotic Coding Course.	Turkey	√	√	√	√	√	√		√	√
3	Cindy, J. G. (2021) Foundation Phase Teachers' Experience of Teaching the Subject, Coding, in Selected Western Cape School.	South Africa	√	√	√	√	√	√		√	√
4	Luisa, G. (2021) Challenging but Full of Opportunities: Teachers' Perspectives on Programming in Primary Schools.	Germany	√	√	√	√	√	√	√	√	√
5	Mukasheva, M. (2021). Computational thinking assessment at primary school in the context of learning programming.	Kazakhstan					√	√			
6	Muhamad Yusof, M. (2021). Exploring Teachers' Practices in Teaching Robotics Programming in Primary School.	Malaysia	√	√	√	√	√	√		√	
7	Wang, J (2021). Use Hopscotch to Develop Positive	United State of America	√		√	√	√	√			

	Attitudes Toward Programming for Elementary School Students.											
8	Predrag, O. (2021). Prospective Teachers' Opinion on Computer Programming in Primary Education.	Croatia	√	√	√	√	√	√				
9	Kjällander, S. (2021). Elementary Students' First Approach to Computational Thinking and Programming.	Sweden	√	√	√	√	√	√				√
10	Ray, P. (2021). Inspiring or Confusing - A Study of Finnish 1-6 Teachers' Relation to Teaching Programming.	Finland	√	√	√	√		√			√	√
11	Monteiro, A.F. (2021). Coding as Literacy in Preschool: A Case Study.	Portugal	√	√	√	√	√	√				√
12	Silva, R. (2021). Fostering Computational Thinking Skills: A Didactic Proposal for Elementary School Grades	Portugal	√	√	√	√	√	√				
13	Tengler, K. (2020). Programming In Primary Schools - Challenges and Opportunities.	Austria	√	√	√	√	√	√	√	√		√
14	Margaret, L. (2020). Teaching Coding and Computational Thinking in Primary Classroom: Perceptions of Australian Pre-service Teacher.	Australia	√	√	√	√		√				√
15	Rosman, N. (2020) Mastering Programming Concept	Malaysia	√	√		√	√	√			√	

	through Blended Learning: A Case Study											
16	Serife, N. Y. (2020). Perceived Acceptance and Use of Scratch Software for Teaching Programming: A Scale Development Study.	Turkey	√	√	√	√	√	√				√
17	Gashawa, A. (2019). Students Perceptions of Programming in Primary School.	Sweden		√	√			√				
18	Agnello, M.F. (2019). Building Human Infrastructure through Programming and English Education in Rural Japan	Japan	√	√	√	√	√	√	√	√		√
19	Mason, S. L. (2019). Preparing elementary school teachers to teach computing, coding, and computational thinking.	United States	√	√	√	√		√		√		√
20	Yukiko, M. (2018). An Investigation into Parents' Concerns about Programming Education in Japanese Primary Schools.	Japan					√	√	√			√

3.1 Teachers' Competency in Teaching Programming

Omar *et al*. (2020) stated that the main purpose of competency is to enable someone to perform more tasks effectively at their optimum level. In educational field, teachers who master the knowledge, skills, and attitudes of subject-matter and designated teaching task could get the fact that they are fully-fledged the competency traits that able to certify them as a teacher. Teachers' competency has greatly emphases on three elements; knowledge, skills, and attitudes. These three elements are interconnected between one after another. In addition, Mason and Rich (2019) stated that teachers must comprehend the subject matter they are teaching, the technology they are employing, and the pedagogy associated with the subject matter, technology, and students if they are to successfully use technology in the classroom. Mason and Rich (2019) also specified that along with expanding their knowledge, teachers ought to enhance their attitudes towards teaching robotics or coding as well as their sense of self-efficacy. From the finding of previous studies, we decided to determine the teachers' competency by 4 key areas which are teachers' programming knowledge, teachers' skill in programming, teachers' attitude towards programming, and teachers' proficiency in digital pedagogy. From 20 chosen articles that have been reviewed, there are 17 articles discussed about the challenges faced by teachers in their competency traits which consist of programming knowledge, programming skill, attitude towards programming, and digital pedagogy. If we want to successfully adopt programming in our educational system, all these four key areas must be prioritized because they are closely tied to one another. A programming teacher must possess all 4 competency traits well in order to implement effective programming class to the students.

The first challenges in teacher competency traits is the programming knowledge. For the knowledge trait, Luisa *et al.* (2021) said that the biggest hindrance for teachers is considered to be cognitive issues, such as insufficient or outdated topic knowledge. A competent teacher will always improve his knowledge as the world changes in order to remain relevant in current education needs. Teachers who lack content knowledge of programming may experience cognitive difficulties to teach their students during the class. According to Misfeldt *et al.* (2019), student achievement will be impacted if the teachers are not well prepared to teach programming. To teach programming effectively, teachers must be well prepared with the content knowledge of programming; for example, teacher must know the programming language well, be able to distinguish the suitable programming tools properly, and so on. This statement is also supported by Cindy and Aslam (2021) which stated that teachers must possess a deep understanding of coding elements including functions, loops, and conditionals.

The second challenges faced by teacher in competency traits is the skills possess by teacher. Binaoui *et al.* (2022) stated that the programming education is newly adopted and many teachers had no idea how to use it. The mastery of programming skills is also crucial in implementing the effective programming teaching and learning session. Teaching programming topics requires a strong foundation in technical skills like computer literacy among teachers. Muhamad Yusof *et al.* (2021) pointed out that technical skills such as computer literacy are also very important in the teaching of programming topics. A teacher cannot be a competent teacher if only possess theoretical knowledge. A good programming teacher should possess both; theoretical knowledge and the hands-on skills. Kjällander *et al.* (2021) in their study found that although teachers are responsible for teaching students to be digitally competent, teachers do not feel they are sufficiently skilled in this area. Low Information & Communication Technology (ICT) skills can cause sessions of programming to be disrupted and more time-consuming. To avoid this situation, teachers need to equip themselves with ICT skills and have a good perception of ICT in teaching. Teachers have a key role as change agents in education. Computer programming skills among teachers will be a catalyst to produce students who can contribute to the development and advancement of digital technology and act as creators of new technology (Alias *et al.,* 2020)

Next challenge in teacher competency traits is teachers' attitude. The attitude and belief of the teacher towards programming education are very important. Teachers must understand the significance of programming knowledge and skills for students to be prepared to face the challenges of their working world in the future. When it comes to evolving educational needs such as the introduction of programming education in primary school, teachers must be optimistic to accept the new changes and try to adapt. However, teachers' attitude and belief in computer science are interrelated with skills and knowledge that are important in developing a competency. Omar *et al*. (2018) stated that teaching without the knowledge of a specific area or subject and knowing what to prepare especially in pedagogical context will demotivate the teacher even further. Students' enthusiasm for learning programming can be influenced by teachers' motivation. A teacher who is inexperienced in programming lacks confidence and is unmotivated to teach. Students will consequently lack motivation to learn as a result of the teacher's ambiguous explanations. Luisa *et al.* (2021) mentioned that teacher should both address content knowledge and affective factors such as attitudes, motivation and confidence in teaching programming.

Other than that, programming teachers also facing with digital pedagogy challenge. Digital pedagogy in teaching programming is crucial to perform a good programming lesson for young learners. Muhammad Yusof *et al.* (2021) stated that computer literacy among programming teachers is very important in implementing programming lesson. To provide effective programming classes for young learners, teachers first must master digital pedagogical knowledge. Without strong digital pedagogical skills in a programming class, teachers will face many challenges. Teachers might not be aware of which didactic features and teaching methods should be used when teaching programming; for example, how to master looking after each student and their programming issues. Younger learners frequently require a lot of assistance, and it can be challenging to get to all of them. Teachers will suffer from the rush when assisting

students. Other than that, many challenges need to be faced by teachers if they lack of pedagogical knowledge to teach programming. Monteiro *et al.* (2021) stated that the challenges included engaging younger children, developing spatial awareness, and controlling children's anxiousness to engage in lesson.

In context of Malaysian education, programming education becomes part of the new curriculum in Kurikulum Standard Sekolah Rendah (KSSR) through a new subject called Teknologi Maklumat dan Komunikasi (TMK) for primary school beginning in 2016. This subject involved level 2 students, consisting students in year 4 until year 6. This subject taught by ICT teachers. However, Muhamad Yusof *et al.* (2021) have mentioned that started in 2020 the students learn programming through another subject namely Reka Bentuk dan Teknologi (RBT) after the TMK subject was abolished under the KSSR Revision 2017. This change presented a significant barrier to teach programming due to teachers' programming knowledge is very limited. RBT subject was formerly known as Kemahiran Hidup (KH). The RBT teachers have extensive training in each of these technical areas involving carpentry, gardening, sewing, and entrepreneurship. The biggest obstacle to RBT teachers performing well in programming class because they are suddenly required to teach programming, which is outside of their area of expertise. In this case, RBT teachers need more exposure and workshop to strengthen their knowledge in programming. The absence of teachers' training and teaching competency in programming and coding at the same time will affect teachers' attitudes and motivation toward programming. Teachers might have negative attitudes and a lack of motivation because of their poor self-concept toward programming. Mason and Rich (2019) insisted that a lack of knowledge in any of these areas; content, technology, or pedagogy could be a knowledge barrier for teachers of coding, computing, or robotics. To gain the competence and confidence to teach computing, elementary schools need effective pre-service and in-service training.

3.2 Students' Readiness to Learn Programming

Another concern in this systematic literature review study area is the student's readiness to learn programming in early education. From 20 articles reviewed, there are 16 articles that discussed on the students' readiness issue. The challenges that occur among young learners are related to cognitive and metacognitive issues.

Cognitive issues are associated with a lack of digital literacy among young learners. Primary school students might be cognitively overwhelmed and might have insufficient prior knowledge regarding digital literacy. Luisa *et al.* (2021) in the study pointed out that the most frequent cognitive issues of a lack of digital literacy are younger students find it challenging to grasp and implement many instructions in programming because they are often still learning fundamental computer skills like how to use a mouse. Conversely, some programming procedures and concepts are too abstract for younger students. The programming language and mediation language are two examples. Young learners will face difficulty in understanding the abstract during programming lessons. Gary *et al.* (2017) stated that primary schools have indicated the following major concerns, such as the lack of coding interest of the students. To make the teaching and learning process easier, teachers and students must be well-versed in the specialized terminologies and programming languages.

The next issue is the use of digital media is also linked to metacognitive challenges. Students might have problems because of metacognitive issues such as being easily distracted. As we know, it is common that young learners cannot stay focused to learn for a long time especially when they lack interest or are overexcited about new things introduced to them. Programming block-based tools like scratch is similar to playing games like roblock and minecraft which they are familiar with. This situation will make the students overexcited and distracted as they consider that they have 'new games' to play with. As a result, they will neglect teachers' explanation and instruction about the programming task because they are too busy exploring 'new games. Sometimes, young learners are eager to explore new knowledge without noticing that they are off track. Luisa *et al.* (2021) stated that keeping children focused is a struggle of its own because they are frequently side-tracked when given an engaging new toy to experiment with. The distraction that occurs in this situation give a challenge to the teacher to achieve the objective of the lesson.

The students' readiness challenges are not only happened in other countries. Programming teachers in Malaysia also face with the same issue. Primary school students in Malaysia are not well prepared to learn programming because most of them still learn the basic of computer literacy. As programming education is newly introduced into our curriculum for level 2 students started in 2016, students seem like difficult to understand the programming language well. Muhamad Yusof *et al.* (2021) in his study in Malaysian schools found that most young students find the programming language difficult to understand. This difficulty faced by the students will make them unmotivated to learn programming.

3.3 Computational Skill

The relationship between programming and computational skill is another concern in this systematic literature review exploration. From 20 articles reviewed, all 20 articles discussed the computational skill issue. It means that computational thinking skill are closely related to the programming education. Computational thinking involves using fundamental ideas from computer science to solve problems, design systems, and comprehend human behavior. Both teachers and students must develop their computational skill to master programming education. Teachers and students need to understand that coding is a language and that there are various coding languages in programming. For example, students practice computational concepts like code, sequence, and loop as they multimodally create and transform programming. Through programming activities, young children can practice fundamental skills including constructing an algorithm, debugging, and testing. Chalmers (2018) pointed out that programming allows students to take part in organized tasks of creating the code sequences required to program a robot, to solve a problem.

Cindy and Aslam (2021) stated that the purpose of programming was to help students improve their ability to think sequentially and to give detailed instructions for solving issues through the use of game creation, instructors improved students' grasp of coding basics including functions, loops, and variables. Programming is more than just coding. It helps students to develop computational thinking which involve problem-solving like abstraction and decomposition. As a result, students gain abstraction and generalization skills, decomposition skills by breaking down complex problems into smaller, more manageable pieces, algorithmic thinking abilities through the structuring of a series of instructions, and debugging abilities through the attempt to fix errors found in their proposed solutions.

This situation hinders the efforts to achieve learning objectives in RBT subjects in the Malaysian context. However, Muhamad Yusof *et al.* (2021) in his research found that according to teachers, students' skills, such as computational thinking skills, are still low. This situation also was explained in a systematic literature review conducted by Mohd Kusnan *et al.* (2020), which involved 19 studies on computational thinking in the Malaysian context. The education department is working on organizing various courses, and seminars to help teachers improve their skills in computational. In fact, studies to assess the competency of teachers before formulating modules to be used in teacher training were carried out. In this programming lesson, teachers are not making students be a programmer, but help the students to use programming and coding tools to solve the task given by using computational thinking.

3.4 School Facilities to Support the Programming Education

In addition, this systematic literature review also noted that school facilities are also among the challenges in implementing programming in primary education. From 20 articles that have been reviewed, there are 10 articles discussed about the facilities issue for programming lessons in primary school. The lack of resources such as technical equipment at primary schools was also raised as a challenge. Ineffective programming teaching and learning sessions can also be impacted by limited access to facilities and equipment. Ray (2021) stated that inadequate equipment and material at school and some pointed out the lack of a broader discussion regarding a more holistic perspective on the implementation of programming in primary school.

According to Agnello (2019), many rural schools lack modern hardware and software, and administrators and instructors have complained about feeling extremely challenged to keep up with the computer programming curriculum. This situation may lead to inequality in education. Because of a lack of resources, teachers can teach students with theory only. Luisa *et al*. (2021) in their study discovered that the majority of teachers claimed that the absence of teaching resources such as robotic sets and pertinent modules led them to exclusively employ simulated or virtual robot substitutes. The high cost of robotic sets makes it difficult for educators to supply for all kids. Therefore, in certain schools, students must share the robots. To teach robotics programming, physical robots are preferable to simulated and virtual robots because they produce more engaging and enjoyable real-world experiences. Physical robots have a greater positive effect on students in this area. Luisa *et al*. (2021) also mentioned about the challenges with school funding, particularly concerning resources' accessibility need to be overcome if we aim for a successful programming education in primary school.

This challenge also faced by programming teacher in Malaysia. Muhamad Yusof *et al.* (2021) in his study found that limited access to equipment and facilities is also an obstacle in pursuing effective programming lesson. The majority of teachers stated the lack of teaching aids such as robotic sets and appropriate modules caused teachers to use only simulated or virtual robot alternatives. Muhamad Yusof *et al.* (2021) also stated that the expensive price of robotic sets creates an obstacle for teachers and schools to provide for all students. In addition, Ali *et al.* (2018) in their research discovered that according to the majority of teachers, students showed high interest in learning programming activities conducted by teachers. Teaching aids, supportive materials, and facilities are very important in implementing programming education. Teachers are not able to teach programming appropriately without adequate resources. Adequate resources used during programming lessons can attract young learners to learn and help them to understand the content easily. The efficient teacher delivery has kept them interested in what they are studying. However, if there are no supplementary teaching tools, such as robotics kits, some students believe that programming for robots is still challenging.

3.5 Parents' Support

The next issue that can be identified through this literature review exploration is parents' concerns about programming education in primary schools. Knowing parents' concerns about programming education is crucial to introducing computer education to primary schools smoothly and appropriately. There are 4 articles from all 20 articles that have been reviewed discussed this issue.

Angello *et al.* (2019) suggested that engaging parents in programming activities at public schools are a good action to expose parents to programming education. As primary students are still young and cannot handle the equipment at home on their own and need helps in completing programming task, they need parents' support in learning programming. Also, once parents have been exposed to the programming education, they will understand the importance of programming education for their children in future job opportunities. This situation will lead the parents to provide support in terms of programming equipment. Parents will try to prepare all the programming equipment and tools needed by their children.

Parents play a crucial role in the primary education of their children, and their views toward education have a big impact on the attitudes of the kids. Gary *et al.* (2017) stated that primary students may need to be more reliant on their parents and self-knowledge in coding. Parent-child collaboration in programming learning is very good to be carried out. Parents' misperceptions and anxieties around programming education may prevent them from becoming actively involved in their children's programming education.

Parents' lack of understanding and awareness about programming education will make their children struggle. Parents should understand clearly about the importance of programming education and try to support this curriculum reform. Parents can support this programming education by providing learning equipment at home if they can afford it. Parents also can support the programming education by helping their children with programming tools. Parents can learn through YouTube and teach their children at home. Luisa *et al.* (2021) stated that if parents are not clear about the aim of programming education, parents might have negative attitudes and there might be a lack of technical equipment at home. Therefore, it is necessary to encourage parents to involve in programming education. Research by Yukiko (2018) discovered that participation in a programming workshop raises parents' expectations and reduces their anxieties about implementing programming education in elementary schools. In Malaysia, we can do the same activity like Angello *et al.* (2019) done which is engaging parents in programming activities at public schools. We can organize a day programming workshop with parents to expose them to the programming education in primary school.

3.6 Government / Policy Makers

Another issue that has been highlighted during the exploration of this literature review is the policy of the government especially focusing on curriculum and time consumption. From 20 articles reviewed, there are 13 articles pointed out this particular issue. Time constrain will be a hindrance to the teachers because of an overloaded curriculum and programming is time-consuming. Gary *et al.* (2017) stated that time constraints for scheduling computer lessons and the government's immaturity in designing a well-defined coding curriculum for young learners are obstacles for teachers to deliver a successful programming session. Luisa *et al.* (2021) in their study found that time allocated in the curriculum for kids to comprehend programming is a difficult task for everyone to accomplish in the given timeframe. This situation also happened in Malaysia. There is limited time to learn programming. During 1 year of learning RBT, there are 8 subtopics to be covered in RBT subject. Time allocation for programming in RBT is too short. 8 sessions of 1 hour lesson for year 4, 12 sessions of 1 hour lesson for year 5 and 10 session of 1 hour lesson for year 6.

Other than time constrain, policymakers also need to focus on supportive material and resources. For example, in Malaysian education RBT textbook is the main reference for teaching and learning sessions. However, the content on programming topics in the textbook can be considered as being too simple and too brief. As a result, various supplemental resources are required to complete the lesson. Additionally, there are no included teaching recommendations for educators. Due to the lack of necessary data, it is challenging for teachers to present comprehensive learning content in this situation. Parties, such as the Curriculum Development Division and the Ministry of Education Malaysia, could identify aspects that can be improved and create guidelines for teachers. At the same time, teachers should also take the initiative to explore and learn more about programming to gain extra knowledge.

Next, the government also needs to do a study on what types of programming tools that suitable for young learners. The study by Serife *et al.* (2020) mentioned that the selection of programming tools should be based on factors such as the target audience, content, and educational environment while considering the stated criteria. Block-based programming tools such as Scratch, Mblock, Alisblock, code.org, thinkerCad circuits, blockly, alice, code game were among suitable programming tools for young learners. All in all, for the programming to be implemented in the best possible way, support structures would need to be put in place, time constraints need to be managed, and adequate resources need to be provided by the ministry of education.

4. Conclusion

In conclusion, we can recognize that there are similar challenges occurs in implementing programming education in primary school level worldwide. As programming curriculum is newly implemented in primary school, it gives difficulties and challenges to many stakeholders; teachers, students, parents, policy makers. Changes in the curriculum always in line with issues for different stakeholders. Each stakeholder will face different difficulties. For teachers, they having issues with their teaching competency and school facilities to adapt with curriculum reform. Students facing difficulties in cognitive and metacognitive issues. Parents will face the anxiety because they are not clear with the objective of programming education and are not familiar with it. While, the policy maker facing with the planning the curriculum issue, training to the teacher issue, decision making on suitable programming tools for young learners, time consuming for programming education in primary school and school allocation budget planning.

From this SLR, we can identify that most teachers around the world facing with similar challenges in implementing programming education in the primary school level. The challenges faced by teachers that occur during teaching programming to young learners are related to teacher's competency traits; knowledge, skill, attitude and digital pedagogy. Lack of any of these 4 competency traits will give bad effect to the students' motivation and performance. Marcin *et al.* (2022) stated that the study of programming presents difficulties for many students. It should be taught by a competent teacher with knowledge of the subject and pedagogy. Teachers need to be well-prepared their self with perceived preparedness for the new curricular reform. Ray *et al.* (2021) stated that perceived preparedness refers to teachers' readiness before the curriculum reform. This preparation includes being familiar with the new curriculum, predicting relevant teaching materials, working together with colleagues to prepare, receiving help from school administration, and self-perceived preparation level. Sáez-López *et al.* (2020) stated that in order to be well-prepared programming teachers, they need to improve their education. Continuous training and extensive professional development involving technical skills and comprehension of appropriate pedagogies need to be provided to RBT teachers (Muhamad Yusof *et al.,* 2021).

The lack of facility provided by the school and government also give a big challenge to teachers in teaching programming. Limited internet access, outdated computer set, absence of robotic programming set, no programming module to refer and expensive programming equipment are examples of the difficulties face by primary school teachers. To overcome the difficulties to implement programming education in primary school, more resources at the school level must be provided including equipment, facilities, instructional aids, and modules. Muhamad Yusof *et al.,* (2021) mentioned that more equipment, facilities, teaching aids, and modules must be provided at the school level to overcome the challenges in implementing T&F of RBT subjects in Malaysia. Sahaat & Mohamad Nasri (2020) also highlighting the need to create additional modules and tools as teaching aids to facilitate learning in the classroom.

Mason and Rich (2019) stated that there are many obstacles prevent primary teachers from teaching computer science properly. Teachers might encounter institutional barriers in the form of unsupportive administrators or legislators, physical barriers like a lack of computers or dependable internet access, and emotional barriers like attitudes, dispositions, and beliefs that prevent the use of technology. According to Tengler *et al.* (2020), it is essential to offer high-quality continuing education for teachers, as well as to offer technical infrastructure and free materials, in order to enable them to address the challenges of computer science education in a meaningful way. To have a better understanding of teachers' experiences, practices, and opinions, further research is required. This would help educational planners and policy maker create a suitable programming curriculum for primary schools in Malaysia. Such research should concentrate on teachers who teach coding in more diverse school situations. Other than that, Muhamad Yusof *et al.,* (2021) suggested that continuous efforts in forming close ties and cooperation between the school with industry players and local universities must be continued for the sake of progress that could benefit students and teachers.

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