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Art-Integration in Computational Thinking as an Unplugged Pedagogical Approach at A Rural Sarawak Primary School

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Abstract
Purpose – Promoting Computational Thinking (CT) in education has become an interest among scholars to develop CT skills to promote critical thinking and problem-solving skills among young people. However, it remains a challenge for Malaysian educators to teach CT at school, especially in rural primary schools. The purpose of this study is to explore the use of visual art in learning the problem-solving process and as an unplugged approach to involve learners in computational thinking.*Methodology* – This study employed qualitative exploratory method to understand the use of visual art as a pedagogical tool for young learners to manifest CT. Twenty-two Primary 4 and Primary 5 students, aged 10 to 11 years old, were chosen as the participants of the study. The participants are from an indigenous community of Sarawak Penan, who used to be nomadic. We used on-site observation to collect qualitative data. The content analysis method was also used to examine classroom activities and participants' task outcomes.*Findings* – Through the art-making experience and unplugged approach, the participants were able to Illustrate their ability to grasp essential concepts of computational thinking – abstraction, decomposition, and algorithms. The CT activities conducted were simple, manageable, and easy to understand. The findings have shown that implementing the art-integration approach in computational thinking suited the needs of the young novice rural learners. The approach was found to be accessible for the local teachers, as it eases the burden of copious preparation and implementation. The approach enabled the teachers to overcome common comprehension problems when relating new foreign concepts to young learners staying in remote rural regions. During the drawing activity, researchers have observed that male students performed better in drawing and abstraction skills, while female students performed better in recognising patterns and colours.

Significance – The findings will help remote rural teachers to reflect on attempts to teach and improve CT instruction using non-computerised materials and incorporate art into other subjects. Our work contributes to the pedagogical strategies that link foreign concepts to indigenous ways of knowing, through the introduction of an unplugged approach and art-integration into the presentation of new learning content. Our work has illustrated how important it is for remote rural teachers to find the right balance between explanation and demonstration of visual worked examples.
Keywords: Computational Thinking, Art-Integration, Unplugged, Rural Primary School

Introduction

The rapid developments of artificial intelligence (AI) technologies, computational thinking (CT) and STEM disciplines have increasingly changed the way education is delivered worldwide. Khine (2018) claims that CT skills are relevant to the advancement of science and technology, and empirical studies were needed to disclose how computational thinking skills are used. The first known computer programmer, mathematician Augustine Ada King, also known as Countess Lovelace, developed computer-generated algorithms into a system that enabled us to use the computer today (Wong, Ma, Dillenbourg, & Huen, 2020). Almost two hundred years on, computer science and engineering experts now have applied computational thinking to design and improve AI technology. CT is a cognitive skill that draws people or machines to problem-solving. It enables the use of multiple thinking skills, such as mathematical thinking, engineering thinking, and scientific thinking to address problems and to produce understandable and practical solutions (Wing, 2008). Many educators around the world have begun to incorporate CT into school curricula to improve CT skills among young learners (Chiazzese, Fulantelli, Pipitone, & Taibi, 2018; Wu, 2018).

Recently, in Taiwan, Wu (2018) used a researcher-developed game design curriculum to operationalise the use of CT skills in the design tasks of middle school young learners. Through a series of design and reflection activities, the study has shown that participants have developed their understanding of the use of design language and fostered by CT skills. It suggests that educational game design activities have benefited novice learners living in urban areas more as the school is equipped with a computer lab, and the young learners are used to digital devices daily basis. However, it is less likely for novice learners living in an isolated area where basic technology tools such as computers are scarcely used in classrooms. Likewise, in Italy, Chiazzese et al. (2018) adapted a game design approach that uses the Microsoft Kodu game development tool to involve elementary school children in computational thinking. Research has shown that design and computer games production have a significant effect on the growth of CT skills and young learners' understanding of computer programming. However, it only had a positive impact on urban children, and it could not confirm its impact on rural children.

In the last few decades, CT skills have been implemented through computerised activities such as Scratch programming (Turchi & Fish, 2019; Wang, Wang, & Liu, 2014), videogames design (Chiazzese et al., 2018; Wu, 2018), digital game-play (Kazimoglu, Kiernan, Bacon, & MacKinnon, 2012). Educators also used non-computerised approach to teach CT skills such as unplugged activities (Brackmann et al., 2017). Unplugged activities involve "physical gestures that are used to reflect and recognise computer science concepts such as algorithms or data transmission" (Brackmann et al., 2017, p. 1). However, many educators overlook unplugged activity as a non-digital strategy to only teach CT skills physically instead of applying art to CT learning. The incorporation of art into learning has a meaning similar to the unplugged approach, which is seen as accessible and non-computerised for teachers and young learners to learn subjects at school. For example, integrating digital technology into the classroom may not be successful initially, as many educators in Malaysia have been struggling to implement technology due to lack of pedagogical knowledge including limited access to training, skills, accessibility and Internet connection (Ghavifekr, Kunjappan, Ramasamy, & Anthony, 2016). This study seeks to address similar issues in Malaysia, particularly in rural primary schools.

Brackmann et al. (2017) found that unplugged activities were used to cultivate learners' interest in computer science and can be used to teach CT skills. However, there are limitations as it covers only computational thinking concepts and partially on CT practices (Brackmann et al., 2017). With the unplugged approach, unexpected result of implementing technology can be avoided, such as PPSMI (*Pengajaran dan Pembelajaran Sains dan Matematik dalam Bahasa Inggeris*) did not help rural school children in science and mathematics as the public examinations did not produce desired results but found more benefits for urban children (Sumintono, 2017; Amparado et al., 2014). PPSMI is an instructional delivery through digital technology such as web-based teaching of the science and mathematics subjects in school. Without proper preparation to integrate technology into the classroom, there is a high chance that teachers and young learners will be confused about learning the subjects. The incorporation of art through the unplugged approach may be suitable as an initial stage for introducing computational thinking skills to rural school young learners.

Computational Thinking in the Malaysian Curriculum

As CT became increasingly popular, the Malaysian Ministry of Education has pronounced the importance of CT skills and integrated CT concepts into the primary and secondary schools curricula (Ling, Saibin, Labadin, & Aziz, 2017). Many schools, however, doubted how digital technology should be deployed in the classroom although most primary schools have acquired at least a few computers for their young learners (Faber, Wierdsma, Doornbos, van der Ven, & de Vette, 2017). Another issue which emerged was that not all the teachers involved had any computing background. As such, it could also affect CT implementation (Curzon, McOwan, Plant, & Meagher, 2014). Meanwhile, most schools in Malaysia are not well prepared to integrate computational thinking, as teachers in rural schools have limited access to technologies and are having difficulty in gaining high-speed internet access (Hamarah & Mohamad, 2020).

According to Anna et al. (2017), computational thinking is a new paradigm and solving problems in the digital era that provides basic knowledge in designing a widespread solution for all areas of knowledge involving decomposition, data representation, generalisation, modelling, and algorithm. As CT can be applied in any fields, it can be challenging to measure, and it should be divided into sub-skills (Anna et al., 2017). CT skills have been categorised in many ways, but there is no real context for learning them, and hardly any materials are developed outside the skill list (Samberg, 2018). Andreea-Diana (2014) suggests that suitable methods for introducing CT-related lessons should be flexible for teachers to ease the burden of preparation and implementation to overcome problems relating to young learners staying in remote rural regions. Therefore, this research is designed to explore the use of art through unplugged activity in manifesting three specific CT skills: i) abstraction, ii) algorithmic thinking, and iii) problem decomposition among primary rural school young learners to learn.

Literature Review

Children's cognitive development

Piaget (1964) stated that children begin to develop knowledge when they can perform specific actions by modifying the object and knowing how to transform the structure of the object. There are two kinds of experience children would encounter in the development and learning, which are physical experience and logical-mathematical experience. In the physical experience, children convey their knowledge about an object by performing operations directly on the object (Piaget, 1964). In other words, for example, children able to experiment to find out the mass of the different size of rocks and make a comparison. In the logical-mathematical experience, children can use logical thinking to transform the object by using mathematical abstraction skills that form a mathematical deduction (Piaget, 1964). Piaget (1964) explained that children were able to demonstrate progress in knowledge and perform mathematical deductions at the age of four or five, using the example of his friend's childhood experience of counting pebbles in one direction and the opposite in the same row. It was concluded that children build their knowledge by making inference without being taught explicitly, using their own experience and logical thinking.

Computational Thinking in Malaysian Classrooms

Of late, promoting Computational Thinking (CT) in education has become an interest among scholars as they realised it was necessary to develop CT skills to promote critical thinking and problem-solving skills among young people (Korb, Hambrusch, Mayfield, Yadav, & Zhou, 2014; Mannila et al., 2015; National Research Council, 2010). However, it remains a challenge for Malaysian educators to teach CT in school (Ling et al., 2017). Based on Ling et al. (2017) findings, the majority of primary school Malaysian educators lacks awareness about CT concepts and never attended any CT-related training that has resulted in Malaysian educators are not prepared to teach CT in the classroom. Although most CT skills are gained through programming, Brackmann et al. (2017) suggested that developing CT knowledge and skill in primary school can be done through unplugged activities. They strongly agreed that CT was a problem-solving competency as a cognitive variable which can be developed without learning how to program (Brackmann et al., 2017). Findings from Looi et al. (2018) supported Brackmann et al. (2017), who claimed that unplugged activities could be used by teachers as an approach to improve the learning process of CT skills.

A computer scientist, Jeannette Wing (2006) described CT as a thinking skill that involves "solving problems, designing systems, and understanding human behaviour, by drawing on the concepts fundamental to computer science." In other words, CT is a meta-cognitive activity involving the formulation of a problem for a computational solution where the solution can be performed either by a human or a computer or both. Wing (2006) emphasised that CT is not only for computer scientists, but also a necessary skill for all to learn much like how humans learn to read, write, and calculate numbers. Learning CT skills from a very young age is highly recommended, as suggested by Lu and Fletcher (2009) and Wing (2006). Lu and Fletcher (2009) proposed that educators should begin teaching the young learners computational processes such as algorithmic thinking to have the basic skill of instructions, instead of learning how to program without an algorithmic skill.

CSTA and ISTE (2011) strongly believe that young learners need to take actions for their learning. Tasks such as designing and creating artefacts could be used to learn how to problem-solve, to demonstrate computational thinking skills work. As a result, they proposed six Computational Thinking concepts for the primary education as a problem-solving process that includes formulating problems, logically arranging and analysing data, representing data through abstractions, such as models and simulations, automating solutions through algorithmic thinking, introducing potential solutions with a focus to achieving the most practical combination of steps and resources, and generalisation of the problem-solving process to a broad range of issues. Brennan and Resnick (2012) see the CT concepts could be further developed into three main areas – concepts, practices, and perspectives. They concentrated on the use of visual-block programmings, such as Scratch, to encourage computational thinking through constructionist design activities among young people. Most areas of computational thinking evolve in the digital programming context without first allowing young learners to understand the basic concepts of computational thinking. It may confuse inexperienced learners. Learners may see Scratch merely as a tool to create objects that are not in the direction of improving their CT skills.

Namukasa et al. (2015) highlighted Hoyles and Noss (2015) definition of CT. According to the authors, CT is one's ability to see a problem at multiple levels of detail (abstraction), organise tasks into sequential steps (algorithmic thinking), segregate big problem into smaller and manageable problems (decomposition), and relate the previous experience to the new problem (pattern recognition). Focusing on the primary school education, Namukasa et al. (2015) emphasised on algorithmic thinking in CT and aligned with mathematical processes in applying the pedagogical processes such as unplugged, making, tinkering, and remixing to bring young girls to think computationally. This study focuses on the unplugged pedagogical approach as an initial stage to enhance primary school young learners in CT knowledge and skills, particularly at rural school whereby practically most of them have no experience using technology in the classroom.

Teaching Computational Thinking via Unplugged Approach

According to Namukasa et al. (2015), the unplugged approach is a teaching and learning experience that utilised non-computers based task. The characteristics of unplugged tasks include collaborative, experiential, motivating and enjoyable activities to keep the young learners stay motivated and ease their learning process in understanding computer science (CS) concepts (Curzon et al., 2014). Tim Bell and his team founded the unplugged task in early 2009. It is also available for free at csunplugged.org. The ideas are to provide schoolchildren to the ideas from computer science without use computers that use activities from games to competitions to manifest computational thinking. Unplugged task has become many choices among educators to teach CS and CT in school because it is simple to implement without the need to worry about having to implement digital technology in the classroom (Bell et al., 2009; Curzon et al., 2014; Faber et al., 2017).

Bell et al. (2009) argued that learning without the use of computers is powerful because of children able to think about computer science issues beyond the programming itself, that includes algorithm, decomposition, and modelling. In response to introduce CT via unplugged approach to young learners, it was discovered that variables were the most challenging programming concepts to teach and learn by novices (Curzon et al., 2014; Faber et al., 2017).

To overcome the challenges, the team established variables as something that can be changed between individual instances of the same object instead of using metaphor. Variables are one of the concepts of computation that required cognitive processes of CT such as Abstraction (Brackmann et al., 2017) and highlighted by Wing (2008) as the most important aspect of computational thinking.

Unplugged tasks are typically implemented in outside of the classroom as informal learning to teach CT skills. However, there is no definite rules of what tasks should be included in the unplugged activities as long as it is non-digital, collaborative, kinesthetics, and motivating for learners to learn CT skills (Kotsopoulos et al., 2017). For example, Brackmann et al. (2017) used paper-based materials as an unplugged approach to expose learners with CT skills such as decomposition, algorithms, and pattern recognition. The unplugged activities including breaking down problems into necessary steps (decompositions and algorithms); find the shortest path between them using arrows orientation (pattern recognition and algorithms); drawing of Tetris pieces when one gives instructions for other to draw (pattern recognition and algorithms) and use of the game board as coding activity (decomposition, abstraction and algorithms).

In this study, we suggest using arts as a part of the unplugged approach to teaching CT skills such as algorithms, abstraction and decomposition.

Adopting Arts as Unplugged Computational Learning Approach

Infusing arts into CT skills allow young learners to find joy during learning. Art integration can also see as the unplugged approach as it is without the use of computers and mostly rely on paper-based materials as a tool. Liao (2016) indicated that introducing art incorporation into the classroom is a good starting point for teachers to teach STEM rather than to incorporate a massive, complex curriculum project. It seemed a useful and creative approach for introducing CT skills to rural school young learners with minimal experience in programming and understanding of CT concepts. Rural area issues have been known as a common topic among researchers, where rural area young learners have insufficient facilities, knowledge of ICT use, and lack of ICT usage (Halili & Sulaiman, 2018). Consequently, it opens a digital divide between rural and urban young learners, leaving rural young learners far from learning in the modern world. Participation in CT practices and understanding CT concepts through an unplugged approach will gradually lead young learners to know CT concepts and develop trust in CT practices and eventually incorporate more abstract computing concepts.

In overcoming the challenges in learning computing concepts, a visualisation tool can help novice learners (Ben-Ari et al., 2011). According to the experts, algorithmic visualisation tools is argued to be useful supplements for students to improve their CT (as cited in Looi et al., 2018). Art can be a type of visualisation which is describes using picture objects and colours. Silverstein and Layne (2010, p. 1) described “Arts integration is an approach to teaching in which students create and demonstrate understanding through an art form”. Consequently, it has raised the interest of the National Art Education Association (NAEA) in the United States, an organisation firmly committed to the importance of STEAM education. NAEA has described the incorporation of art and design values and techniques into STEM teaching and learning as a new approach for teaching STEM and has concluded that young learners can also learn other subjects through the arts (Liao, 2016). From the concept of art integration, it holds critical vital terms that described close links with the arts and education (Silverstein & Layne, 2010). Similar to an unplugged approach, this approach to teaching is consistent with Constructivist learning theory, which builds on young learners' experience, offers constructive hands-on learning of real-world problems for them to solve, and creates opportunities for young learners to learn from each other to improve their understandings. It is, therefore, a very positive and realistic approach to teaching rather than what to teach (Silverstein & Layne, 2010). Through art-making, young learners can build and illustrate their understanding of the topic in a straightforward way that helps them learn and retrieve information that they have already learned and slowly deepened their understanding. It connects young learners' knowledge with the real-world application and enhances their learning process.

Arts-integration not only limit to art-making but also involves other activities such as performing dance, music and drama (Dana Foundation, 2008). A private philanthropy organisation with concerns in neuroscience, immunology, and arts education, Dana Foundation (2008) has established a strong connection between arts education and cognitive development, where performing arts enhances state of motivation but also improves performance and the training of attention of the learners. Marshall (2005) reveals that linking arts to other fields of inquiry considered a good pedagogy because it is consistent with the way the human mind works. He added that art-making encourages creative play with ideas and whimsical projections of abstractions into new contexts. However, there are disadvantages to CT learning from this point of view. It is because creating art images for learning involves abstract imagination and visual representation of the mind. Young learners find it challenging to visualise CT concepts during the art-making as an individual (Kramer, 2007; Waite, Curzon, Marsh, Sentance, & Hadwen-Bennett, 2018), thus enabling collaborative learning to shape the discussion and connect. Through arts integration, it is an easy and practical way of learning CT at a granular level. Therefore, making meaning through visual arts is a concern for art educators as it represents young learners' understanding of the subject (Marshall, 2005; Sullivan, 1993).

Theoretical Framework

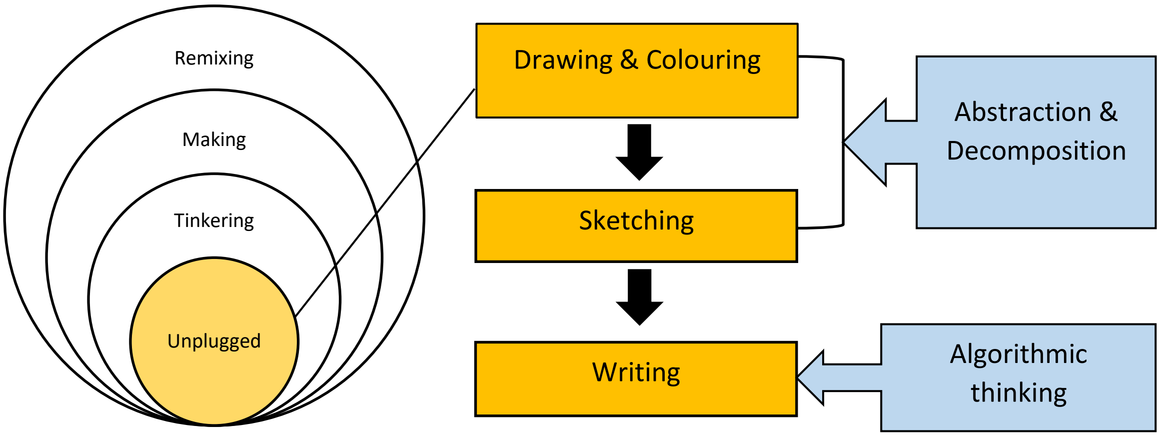

Figure 1: Unplugged Pedagogical Approach for Computational Thinking Skills Framework

The theoretical framework of the study harnesses on the idea of using art as the pedagogical approach to teaching computational thinking to young learners in the rural school. The integration of art as an unplugged approach brings a new perspective in the Computational Thinking Pedagogical Framework (CTPF) model. According to Kotsopoulos et al. (2017), teaching computational thinking to novice learners is best starting with unplugged activity. It is because learning new concepts and skills such as CT, in the beginning, should require the least cognitive demand and technical knowledge. However, educators can also introduce higher-level CT concepts through either conceptually or technologically in other experience (Kotsopoulos et al., 2017).

Previous studies have shown that use of art brings meaningful and authentic in learning which also links to creativity (Marshall, 2005; Sullivan, 1993). The literature revealed that there is a strong correlation between the work of visual arts, geometrical reasoning and scientific observation skill, although the causality has yet to be confirmed (Winner, Goldstein, & Vincent-Lancrin, 2013). Art education in Malaysia has been recognised as a compulsory subject in public primary schools, and it is not included in the school examinations (Liau, 2018). It shows that the Malaysian educational policy did not put art as an essential subject when compares to other subjects such as mathematics, English and science. Furthermore, art education has never been integrated with other subjects in school, particularly in Malaysia.

In contrast, art plays a vital role in STEM education as an assessing tool allowing inquiry, dialogue, and creativity to happen and fosters the thinking skills development (Xanthoudaki, 2017). Research also found that computer graphics designer and also engineers require art skills to have engineering skills where those skills are needed to ensure successful algorithms to happen (Psycharis, 2018). However, minimal studies have been done to adopt art as a pedagogical tool to teach young learners about CT. Therefore, this study aims to explore the use of visual art in learning CT concepts and regarded as the "unplugged approach" in which the activity will be conducted without the use of a computer.

Methodology

Research Design

A qualitative exploratory research design was practised in this study to understand the use of visual art as a useful pedagogical tool for young learners to manifest CT. The research design was chosen as it enables researchers to uncover the central phenomenon and values of the subjects (Creswell & Plano Clark, 2018). We used on-site observation to collect qualitative data.

Research Questions

1. How do young rural learners manifest computational thinking skills through art integration and unplugged approach?
2. Does the art-integrated approach help learners to manifest computational thinking skills?

Participants

The participants were selected from a remote primary school at a remote rural location in northern Sarawak Borneo. Twenty-two Primary 4 and Primary 5 learners, aged 10 to 11 years old, participated in the study. They equally represented both genders. These participants are a group of indigenous people and rooted from a homogenous cultural background where they live in a community that used to regularly moved from one place to another in the same area. At the time of the study, the community has settled near a river for more than thirty years. They regularly go out and hunt for food in the jungles. They plant their rice and vegetables.

There is no road access to the location. Access is only sought upstream through a riverway. The community have managed to acquire help from various groups to install hydro-electric solutions to generate power and to install dry compost toilets as a solution for waste management.

Instructional Design
The study utilised problem-based learning as a critical instructional approach to design Computational thinking activities. The CT activities were implemented by three stages – Abstraction, Decomposition, Algorithmic.

Abstraction Activity
Before starting the activity, the instructor explained to the participants about the learning objective of the activity. The learning objective is to learn how to solve a given problem using an abstraction skill. The participants were briefed on the example of a real-life travelling situational problem. Then, they were given to similar problem to solve with specific conditions such as the end product should have the name of places, boat, and time of departure and arrival. The story is described as follows:

"Their school (L1) was selected for a regional school competition of the badminton match at L3 primary school. They represent the badminton school team to participate in the match. L2 is a transition between L1 and L3. There are three places in the situation, namely L1, L2, and L3. They were given the following conditions: i) the competition would start at 10 a.m.; ii) the travel one place to another requires one hour; iii) one of the team members has forgotten to bring the badminton rackets; iv) they have to set their own time of departure (they would need to carefully consider the time of departure and return because the decision will affect their time of arrival); v) decide which solution would be the best to solve the problem."
Five minutes was allocated to the team members for discussion. After the discussion, they need to describe their ideas based on the given situation drawn on the drawing paper.

Decomposition Activity
Once they were done, they would sketch a linking map with paths and appropriate labelling as a simplification of the travel map and utilised the decomposition skill. In the decomposition activity, it described the use of mathematical representation of a network graph to represent the paths (number of travel) and labels (location). After that, they needed to explicitly state the problem and solution below the map they had drawn before.

Algorithmic Activity
Each participant was given a piece of blank grid paper. Each participant should randomly pick a location or coordinate for each label, then connect each coordinate with a curve line to form a pat. Then, they wrote it as an algorithm. Each of the locations was labelled. Participants are encouraged to write down and defined the meaning of the key characters to avoid confusion when writing the algorithm. The CT activities were organised according to CT skills as follows:

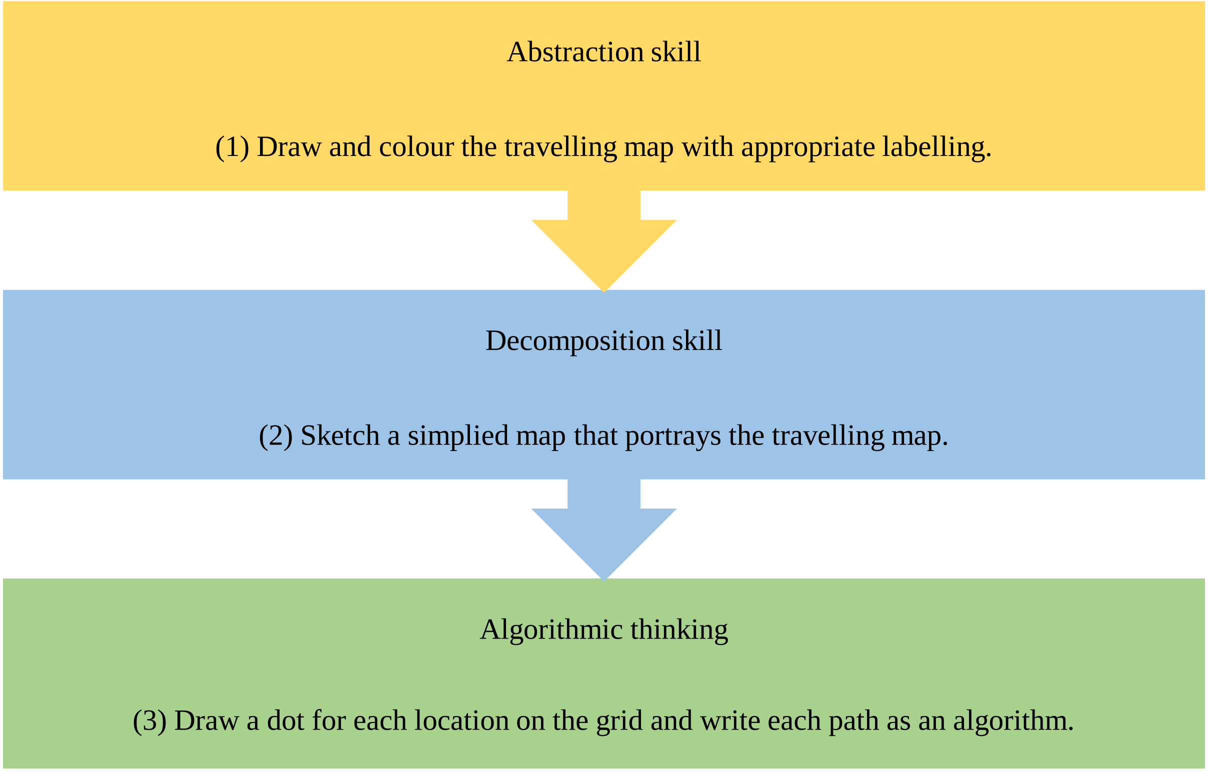

Figure 2: List of activities based on CT skills

Data Analysis Procedure

The content analysis was used to examine classroom activities and participants' task outcomes. We used the analysis to transcribe participants' interactions during the CT activities. The participants' task outcomes were analysed to examine participants' understanding of the CT concepts – abstraction, decomposition, and algorithms.

Findings

Drawing and Colouring

The findings showed that the participants able to demonstrate abstraction skill through drawing and colouring. Based on the observation, one of the groups started to have a brainstorming session with their peers to decide which elements they should draw first. Once they have decided, the team members took their role and started to sketch on the drawing paper. Some of the participants started to draw the objects by ordering from the structure of the school, then the river and boat. Meanwhile, the other draw the plants, the Sun, and the cloud. The order of the drawing elements showed by the participants are using abstraction thinking skill by prioritise the most important one and ignore the least essential details, and analysing skill. These observations are similar to the problem-solving process or computational thinking where the participants formulate problems, logically arranging and analysing data, representing data through abstractions (CSTA & ISTE, 2011). Although it is not evident to the participants that the art-making activity as an unplugged activity as one way to discover CT skills, it helps them to understand abstract concepts like the location of the school through the representation of objects using arts and drawing.

The participants were observed as collaborative and content during the drawing and colouring activity. They have a perfect sense of ownership and team spirit (see Figure 2). Despite the gender difference, all young learners loved art-making activity. However, when it comes to the drawing and colouring art activity, females are more prone to colouring while males preferred to drawing arts. Among the groups, males tend to draw most of the arts in the drawing activity. It shows that males are better in drawing and abstraction skill while the female is better in recognising patterns and colours. It supports the claim of unplugged activity is a useful and creative approach for introducing CT skills to rural school young learners with minimal experience in programming and understanding of CT concepts.

After finished with the drawing, they started to colour each of the elements. Choosing the right colour is important because they need to match the colour correctly according to the elements of the real-life experience. This process requires logical thinking and personal experience. These participants coloured the objects similar to the real experience, similarly, illustrate their knowledge about an object through action by performing operations directly on the object in which in this study, based on physical experience, according to Piaget (1964). Thus, these young learners have no difficulties in demonstrating their abstraction skill through drawing and colouring activity which is natural and suit their learning interest.

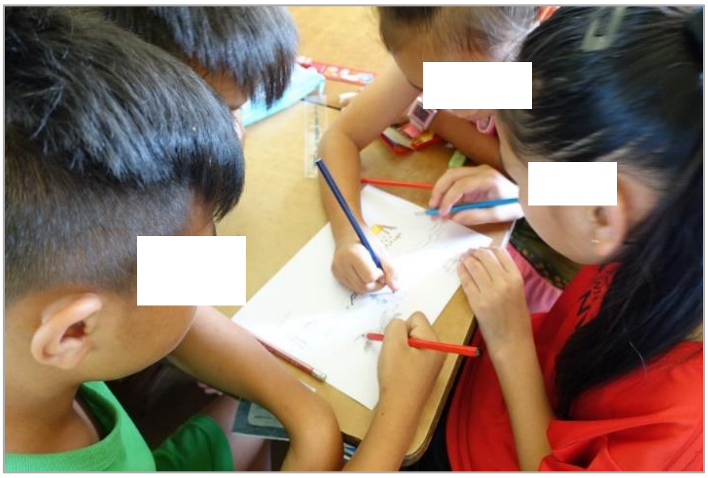

Figure 3: A participant group collaborated in the drawing and colouring art activity *Sketching*

During the sketching activity, each of the groups requires to draw a linking map based on the visual arts they produce earlier. This learning activity is essential because it requires both abstraction and decomposition skills, whereby the participants choose what should be included and what should not be included on the linking map. Figure 3 illustrated the product produced by one of the groups whereby they need to transfer the first product (with colour) into a simplified version map (without colour).

The simplified map in Figure 3 showed that important components are labelled, such as the name of the location, time of departure and arrival, problem, and solution. At the same time, the three lines with arrows indicate the path taken by the traveller to travel from one place to another instead of using only one line to indicate the starting and endpoint to the destination, which also similar to segregate big problem into smaller and manageable problems (as cited in Namukasa et al., 2015). Each of the details is essential to be highlighted, and these components also illustrate one ability to utilise the decomposition skill. As concluded, the sketching activity helps the participants to pay close attention to details of objects besides using decomposition skill to demonstrate the level of understanding towards the topic.

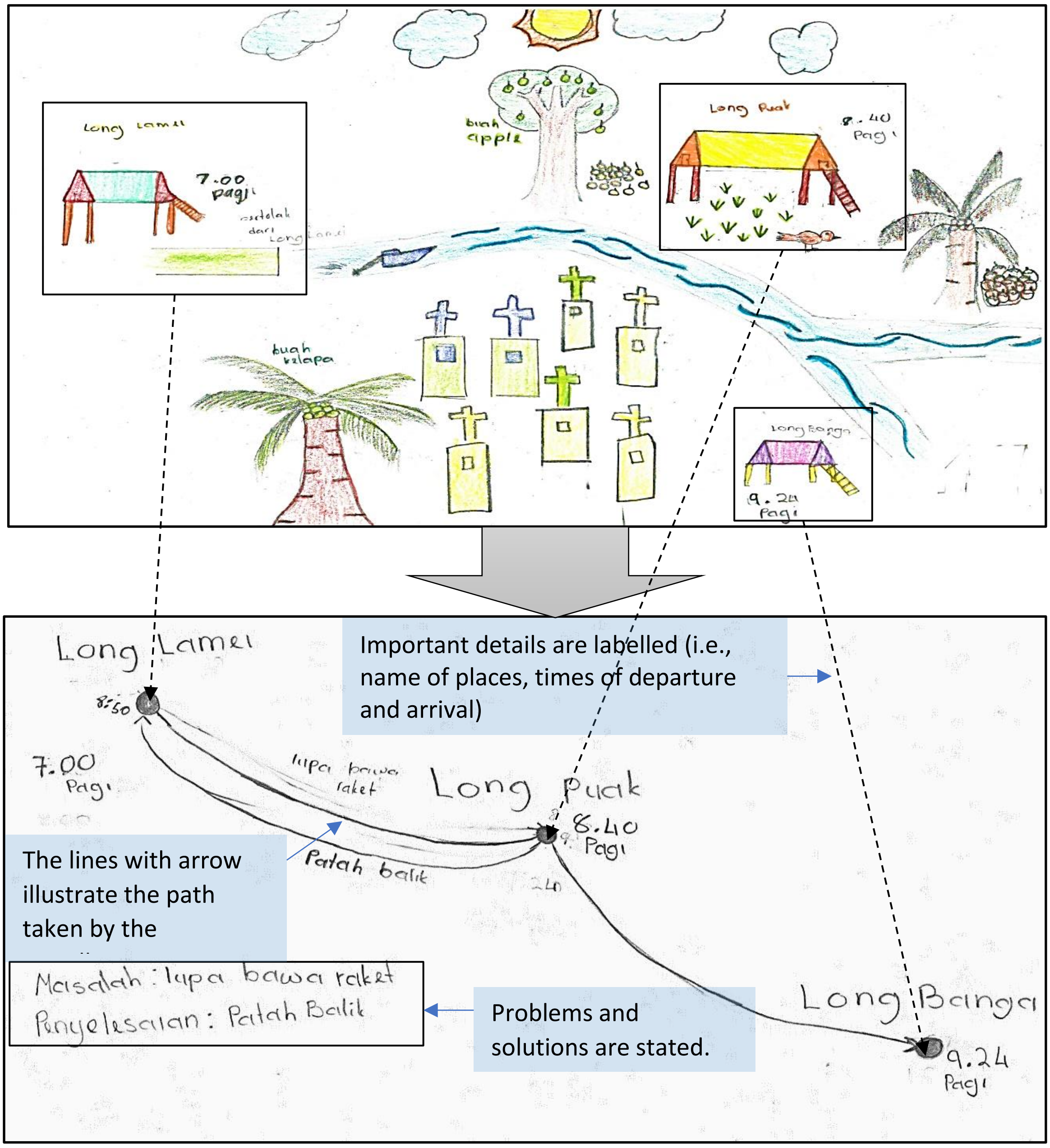

Figure 4: One of the maps constructed by a group of participants

Writing
After the sketching, the concept of coordinate and algorithm writing was introduced to them. The participants were asked to randomly pick the coordinate for each location with an approximate distance. Each of the locations is labelled with an abbreviation of the location's first letter of each word (e.g. L1). Then, they were required to define each label on the bottom of the grid. These steps are necessary to avoid confusion for the readers and the writer.
Furthermore, they are guided on how to write an algorithm (see Figure 4). Initially, most algorithms written by the participants had errors. Using prompts, they tried to write the algorithms again. Through a trial-and-error approach, the participants were able to learn

from their mistakes and eventually were able to identify what went wrong. In due course, they began to understand how to write an accurate algorithm. The outcome of the algorithm is illustrated in Table 1.

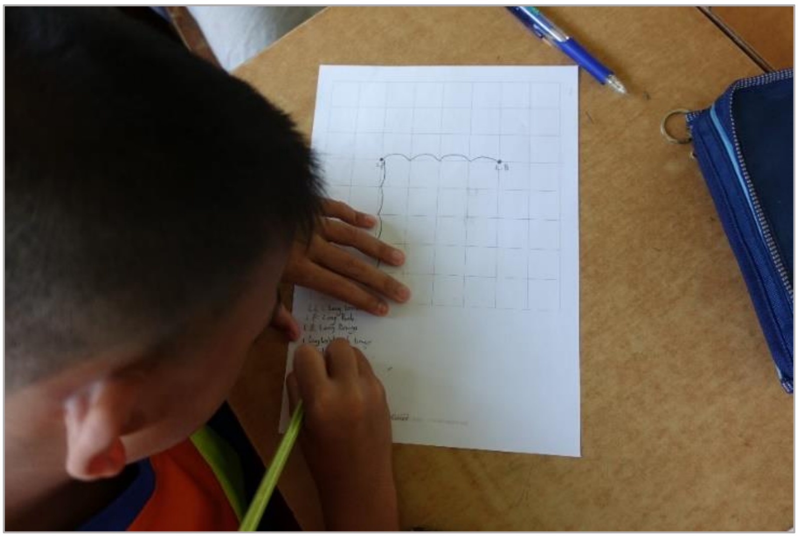

Figure 5: A participant writes an algorithm based on the path and direction of the object's coordinates

Table 1:
Example of Algorithms Formula Based on the Path

Start to End	**Example of algorithm formula**
L1 → L2	Start Four steps forward Turn right Four steps forward End
L2 → L3	Start Turn right Four steps forward End

Through the art-making and unplugged practice, learners have been able to grasp the basic principles of computational thinking quickly that is abstraction and decomposition. These CT tasks are quick, manageable, and easy to understand for rural young learners, which is also essential because these learners are new to CT concepts. Algorithms concept was challenging for some participants to understand at first, but with proper guidance and trial-and-error activity, they able to learn the concept better. It supports the argument put forward by Andreea-Diana (2014) that appropriate methods are required for the introduction of CT-related lessons should be versatile for teachers to ease the burden of planning and implementation to address the problems of young learners living in remote rural regions. Not to suggest that these learners are not able to learn complex CT concepts, but instead that these learners need more time to process for information and learning through a step-by-step process. The slow-paced (low-level CT skills) learning will enable them to understand CT concepts better. However, they need to have at least basic CT knowledge and skills before learning advanced CT skills. As Lu and Fletcher (2009) have pointed out, educators should begin teaching young learners computational processes, such as algorithmic thinking, to have the basic instruction skills, instead of learning how to program without algorithmic skills. Thus, mastering basic CT knowledge is necessary to allow learners to advance their CT skills and transfer them to other related areas. For instance, algorithmic skill enables learners to construct and structure program and be innovative to solve a real-world and practical problem.

Conclusion

The findings of this study indicate that CT skills can be taught and demonstrated through art incorporation and unplugged approach with appropriate preparation and training approaches to improve the awareness and interest of learners in developing CT knowledge and skills. According to Xanthoudaki (2017), art plays a vital role in STEM education as an assessing tool that allows inquiry, dialogue, and creativity to take place and promotes the development of thinking skills development. Teachers should, therefore, integrate art into teaching and learning lesson plans to help learners to extend their CT knowledge and skills, not only to learn one subject as a discrete subject but also to allow learners to learn a variety of knowledge through practical pedagogical experience. Art-integration and unplugged approach should be implemented appropriately in the teaching of CT so that more learners can appreciate CT in their learning process, despite having limited resources at school, particularly in rural areas. Therefore, educators should revisit and examine how CT skills could be incorporated into Malaysian primary schools' curriculum and gradually improve their teaching practices.

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